have many facets, that knowledge from many fields must be pooled, and that the work of many different researchers must be carefully coordinated if the results desired are to be obtained.

Thus the Depot of Charts and Instruments, forerunner of both the Naval Observatory and the Hydrographic Office, was established by the Navy in 1830. The first of the Navy's exploring expeditions was sent out in 1838, under Lieutenant Charles Wilkes. In 1849 the Nautical Almanac Office was established. Associated with it in its early years were such outstanding men as Lieutenants Charles Davis and Matthew Maury, Superintendent Alexander Bache of the Coast Survey, Dr. Joseph Henry of the Smithsonian Institution, and Professor Benjamin Pierce, leading mathematician of his day. Three of these men—Davis, Bache, and Henry—were the members of the "Permanent Commission" set up by Secretary of the Navy Gideon Welles in 1863 to advise the department on scientific matters. The success of this commission led directly to the charting by Congress in 186... the National Academy of Sciences, to pro... such service to all departments of the Gov... ment.

Among other early steps taken by the N... to organize scientific effort was the establi... ment of research and testing activities in ... rine engineering and ordnance. In 1866, ... example, a device for testing lubricating ... was installed at the New York Navy Y... Three years later the Naval Torpedo Stat... was opened at Newport, Rhode Island, to ... velop and test torpedoes, torpedo equipm... explosives, and electrical devices. The exp... mental battery and range that had been set ... on the eastern branch of the Potomac in 1... to test naval guns was moved to the Sev... River, near Annapolis, in 1872, at which t... its facilities were greatly expanded; 20 ye... later it was again moved, this time to Dahlgr... Va., to accommodate increasing ranges, ... was made into a fully equipped naval prov... ground.

Again, in 1896 the Navy Department ... tained congressional authorization for an ... perimental model basin, which was placed ... operation at the Washington Navy Yard ... 1900. Since moved to Carderock, Maryland, ... David Taylor Model Basin is now the wor... finest research laboratory for the developm... of optimum hull forms and the gathering ... much-needed information about the behav... of ships in water. Today it is in the lead ... research on hydrodynamics, ship construct... and ship propulsion, and also carries on sig... cant work in aerodynamics and mechanics.

Shortly after the turn of the century, t... Bureau of Steam Engineering (now inco... rated in the Bureau of Ships) established ... Engineering Experiment Station at Anna... and the Fuel Oil Burning Laboratory (s... 1941 the Naval Boiler and Turbine Laborat... at the Philadelphia Navy Yard.

Throughout the period just reviewed, i... vidual naval officers, with or without fo... training in science, appreciated the cont... tions that science might make to the ... tion of naval problems. Lieutenant Maur... Superintendent of the Depot of Charts ... Instruments, stimulated research in astron...

RESEARCH IN CHEMISTRY
The Office of Naval Research is conducting far-reaching programs in many fields of basic science.

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...ogy, mineralogy, and oceanography. Rear ...iral John A. Dahlgren, often referred to as ...ather of modern gunnery, built the Navy's ...s big guns, advocated the development of ...tive gun sights, and insisted that naval ...s be rifled. In the early 1890's Lieutenant ...liam S. Sims made a thorough investigation ...European gunnery practices; subsequently, ...was extraordinarily successful in applying ...scientific method to the development of gunnery training and fire control. Lieutenant Bradley A. Fiske introduced the range finder, telescopic sights, and director fire into United States Navy practice, and advocated the development of the torpedo plane. As early as 1901, five years before HMS *Dreadnought* was launched, Lieutenant Homer Poundstone designed an all-big-gun battleship. Many other outstanding contributions to science were made by naval officers.

RESEARCH IN TWO WORLD WARS

...ld War I

...fter Europe had gone to war in 1914 but ...re we had entered the conflict, the Navy ...partment, keenly aware of the rapid changes ...g made in naval warfare, took steps to put ... effect a more completely organized pro...m of naval research and development. To ... end the Naval Consulting Board, popularly ...own as the Inventions Board, was established ...1915, as a means of mobilizing the nation's ...nical skills. Under the chairmanship of ...omas A. Edison, it was made up of two ...ders from each of eleven outstanding techni... groups and scientific societies of the country. ...ddition to serving the Navy in the capacity ... which it had been created, this Board ...anized the nation's Industrial Preparedness ...mpaign and recommended that the Navy ...partment establish a permanent experiment ... research laboratory.

...n like manner the National Academy of ...ences set up the National Research Council ...a working organization by which the re...rces of different groups of scientists could ...rought to bear in the solution of the major ...ntific and technical problems of the War ... Navy Departments. In this way, research ...the greatest importance was undertaken in ...h fields as submarine detection, gun ranging, ... naval camouflage.

...oth the Naval Consulting Board and the ...onal Research Council contributed to the ...elopment of antisubmarine warfare devices, ... successful development of which had been ...e imperative by the prowess of Germany's ...marine campaign. From the Consulting ...rd came the design for a nonricocheting shell, from the effects of which a submarine could not escape even if partly submerged. Another device produced by the same organization was the hydrophone, by which the noise of a submarine's engines could be heard at some distance, the sound waves being transmitted by the water. This equipment enabled its user to determine the direction and the distance of the boat spotted. As worked out at New London, Connecticut, the hydrophone played a signifi-

NAVAL SCIENTIST AT WORK
Science and national security are closely related.

cant part in winning the first Battle of the Atlantic.

In its race to defeat the Kaiser's submarines, the Navy also developed the "antenna mine" discussed in a previous chapter. The new mine, produced by Ralph C. Brown and Admiral Ralph Earle of the Bureau of Ordnance, was used in the great North Sea mine barrage which did so much to restrict U-boat operations.

The Navy also took steps to protect both merchant ships and its own vessels against submarine attack by the development of "razzle-dazzle" camouflage. Enemy submarine commanders made errors of as much as eight degrees in aiming at ships so painted.

Between World Wars

As has been seen, research had been greatly stimulated during World War I, especially in the field of naval weapons and counterweapons. As a result, immediately after the end of that conflict the United States Navy undertook an expansion of its research facilities. Outstanding in this program was the establishment of the Naval Research Laboratory in 1923 and the conversion of the Mine Laboratory into the Naval Ordnance Laboratory in 1929.

In 1915 Thomas A. Edison, as Chairman of the Naval Consulting Board, had urged the creation of a laboratory to be devoted entirely to naval research. Congress voted funds for this purpose the next year, but it was not until 1923 that work was completed and the Naval Research Laboratory (NRL) was formally opened at Anacostia, D. C. Its operations during the next two decades contributed greatly to preparing the Navy for its effective participation in World War II; in particular, they provided an accumulated body of knowledge on which our scientists and technologists were able to draw for development of radar, the proximity fuze, and the atomic bomb.

Commenting only on the background work leading up to radar, we find that scientists at NRL began experimenting with radio direction-finding equipment almost as soon as their laboratories were opened. As early as 1930 a formal report to the Bureau of Engineering proved so promising that they were directed to "investigate the use of radio to detect the presence of enemy vessels and aircraft." At the reques... Rear Admiral Harold G. Bowen in 1935, C... gress allocated $100,000 to NRL for carry... on this development, and by April 1937 ... Navy had radar working over salt water fr... the old four-stacker *Leary*. From such sour... came this deadly antiaircraft and antis... marine device.

The Naval Ordnance Laboratory (NO... likewise conducted valuable scientific investi... tions during the period between the wa... Established by the Bureau of Ordnance as ... Mine Laboratory in 1918, its original assi... ment turned principally on the development ... an improved type of mine-firing device. S... sequently transferred to White Oak, Maryla... and renamed Naval Ordnance Laboratory, ... now conducts an extensive program cover... research in and the development of torped... mines, depth charges, mine-launching equ... ment, fuzes, pyrotechnics, ordnance parachut... demolitions, guided missiles, plastics, gu... armor, and minesweeping equipment.

Another important establishment provid... for during the war but actually doing some ... its most important work during the peace whil... followed, was the Naval Aircraft Factory, fir... set up at the Philadelphia Navy Yard in 191... With the advent of the airplane, a new field ... engineering and technology was opened. Th... David Taylor Model Basin undertook the co... struction and operation of one of the first wi... tunnels in the United States for studying th... aerodynamics of flight, but it soon became a... parent that additional facilities and arrang... ments for aeronautical research were bad... needed. The Navy fostered the idea of a Na... tional Advisory Committee for Aeronautics, a... Congress in 1915 established such a committ... to "supervise and direct the scientific study ... the problems of flight with a view to the ... practical solution" and to "direct and condu... research and experiments in aeronautics." Tw... naval officers are members of this Committe... which for many years was housed in the Na... Department. In 1921 the Naval Aircraft Fa... tory began work on experimental aircraft an... in cooperation with the Committee, made sig... ficant contributions in the field of aerodynami... It was a group of enthusiastic naval officers ...

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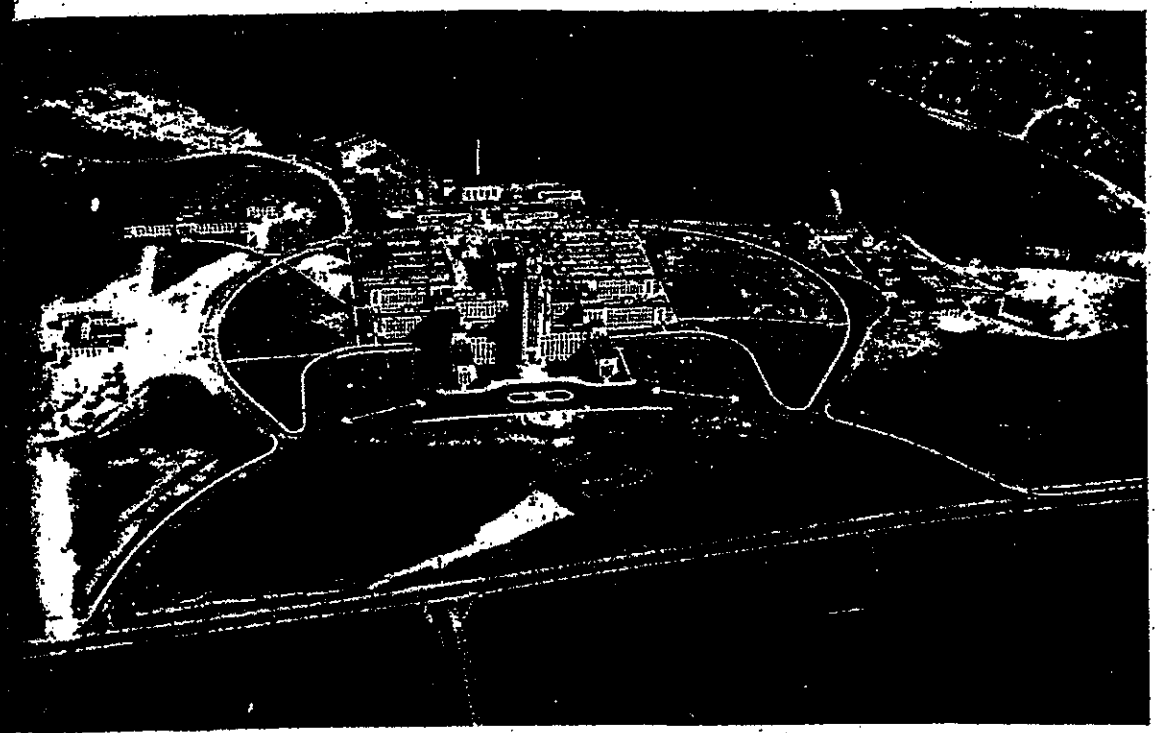


MEDICAL RESEARCH CONTINUES IN PEACE

Broad program of medical research is conducted by the Navy. Among the buildings of the National Naval Medical Center in Bethesda, Maryland, is the Medical Research Institute, one of the best-equipped laboratories in the world.

e Naval Aircraft Factory who advocated the velopment of guided bombs or planes years fore the Germans were to make the first re- rded combat use of radio-controlled missiles.

When the long-threatened World War II gan in September 1939, and the United States unched its program of national defense, the avy had already laid the foundations by ientific research for its growing strength.

orld War II

World War II marked the largest mobiliza- n of scientists in the waging of war that the orld has known. It was the physicist working letly in his laboratory who developed the oustic fundamentals on which were based the tisubmarine devices that helped the United ates Navy defeat the U-boat and strangle pan by power beneath the surface of the sea. e mathematician working on his differential uations and mathematical formulas gave to r Armed Forces the fundamentals of fire control and helped create the computing devices for the gun directors and airborne torpedo directors that played so important a part in the attainment of final victory.

Realizing that superiority in new weapons would be essential in defeating the enemy and that this superiority depended on scientific knowledge, President Roosevelt in June 1941 established the Office of Scientific Research and Development (OSRD), to coordinate and, where necessary, to supplement scientific research and development work relating to the war. The nation thus set up the machinery to enlist its scientists in the fight against the enemy.

The Navy immediately established an Office of Coordinator of Research and Development which, under Rear Admiral Julius A. Furer, handled the necessary Navy liaison with OSRD. The Navy was ready and eager to work with OSRD and was able to offer to this organization its facilities and experience in research and development programs. The application of the

products of science to warfare is a slow process. It takes years for a new weapon to pass through the successive stages from the first idea to research, development, testing, quantity production, and finally to actual use. The groundwork already laid by naval research workers was to save priceless time.

Examples of the Navy's preparedness for war through science are given by Dr. James P. Baxter in *Scientists Against Time*, his Pulitzer prize winning account of the OSRD's activities during the war. A few quotations are presented here.

Fire Control. The Navy "had gone a long way in developing fire control. . . . Our Navy's systems of fire control were the best in the world."

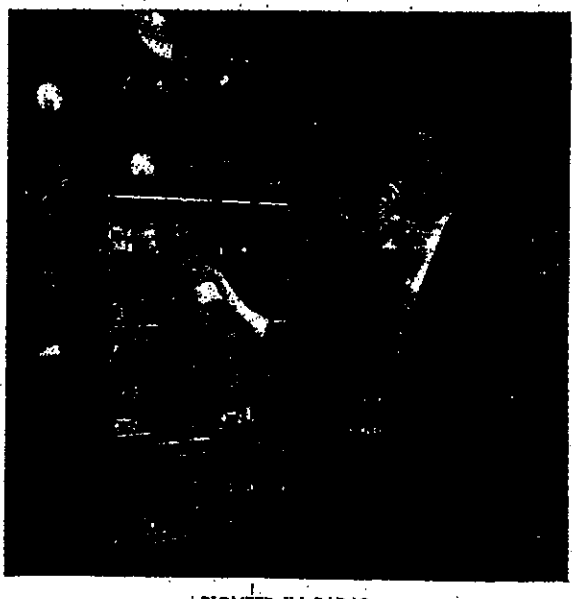
Proximity Fuze. In discussion of the development of the proximity fuze which ranks "among the most extraordinary scientific achievements of the war," Dr. Baxter states, "When the OSRD was established, the problem of proximity fuzes had already been under consideration for some time in the United States Navy."

Undersea Warfare. "The United States Navy started the war with well-developed echo-ranging gear. . . . Between the two wars the Nav Research Laboratory had made notable cont butions to supersonic echo-ranging gear."

Radar Countermeasures. "At the Naval R search Laboratory, where radar had been und development for years, the possibilities of cou termeasures had also been explored. Prior our entry into the war NRL had developed wide-band crystal receiver to pick up enem transmissions and determine their frequenc and had under development a receiving set cover the range from 50 to 700 megacycles."

Atomic Bomb. As early as 1939 Rear A miral Harold G. Bowen, then Chief of Bureau of Engineering, allotted $1,500 to Naval Research Laboratory for experiments pilot plants for the concentration of Uraniu 235. This was the first government work, at the time the only government work, on project which grew into the atomic bomb velopment. Later, when the Manhattan Distri coordinated all work on the bomb, a therm diffusion plant needed for the partial separa tion of U-235 was built along lines which Ba ter reveals "had been worked out by R. Gun and P. H. Abelson at the Naval Research Labo ratory and tested in pilot plants built by th Navy at Anacostia and Philadelphia."

The Navy had indeed been mobilized fo 20th-century warfare. Years of systematic re search paid dividends when in 1940 Congres voted a 70-percent increase bill that gave Amer ica a two-ocean Navy. But the power of thi fleet lay in the new capabilities with whic previous research had endowed it. *The ne fleet was fast:* In battleship construction alone by adopting a relatively narrow beam with ligh armament, powerful engines were capable driving the vessel at a speed estimated in some quarters as 35 knots. *The new fleet was superbly equipped:* It could maintain itself longer at sea and cope with land-based air power and sub marines while thousands of miles from home and close to enemy bases. *The new fleet ha eyes to see hundreds of miles away:* With radar the fleet could scan the ocean for surfaced sub marines and the skies for aircraft for more than 150 miles at all times of day or night re gardless of weather. *The new fleet was well protected:* Destroyers and destroyer escort



PIONEER IN RADAR
A well-known scientist examines one of the elemental radio tubes in the first radio set at Naval Research Laboratory, Anacostia, D. C.

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POST-WAR RESEARCH

Plans for Continued Progress

At the close of World War II the Navy faced a new and perplexing problem: the disposition of an unparalled collection of research and development facilities. Never before had it possessed laboratory resources of comparable magnitude. Fortunately, naval leaders knew that the Navy's technological future might well depend upon the continued existence of these facilities. With the lessons of World War II clearly in mind, the Navy set about the task of creating, within itself, the capacity for continuing material development and technical progress.

In addition to maintaining those laboratories that existed prior to the war, such as the Naval Research Laboratory and the David Taylor Model Basin, the Navy welcomed into the family of naval shore activities other laboratories which, under the National Defense Research Committee and through contracts with universities, had been devoting their wartime efforts to naval problems. In this latter category were such activities as the Naval Electronics Laboratory and the Underwater Sound Laboratory. Still other laboratories created during the war, or later established to meet peacetime requirements, included the Naval Radiological Defense Laboratory and the Naval Biological Laboratory at San Francisco, the Underwater Sound Reference Laboratory at Orlando, Florida, and the Naval Air Development Center at Johnsville, Pennsylvania. This listing gives only a partial picture of the scope of these activities, since during this time the Navy was operating over forty research and development installations.

These laboratories, to meet the needs of their parent bureaus and offices, embarked on programs running the gamut of scientific and engineering interests. With the production programs of the Navy at a virtual standstill, wartime emphasis on the development of specific end-items of equipment were modified. Research was undertaken to extend the knowledge required for specific technological purposes, and efforts were made to apply such knowledge to broader development needs. These "applied research" programs formed the bulk of the peacetime naval laboratory program, augmented on the one hand by lesser efforts of even a more fundamental scientific nature, and on the other by prototype development of new weapons and equipments.

At naval medical research establishments the health needs of men working and living in varied climates and under varying conditions were also being explored by naval scientists. The best kinds of clothing, food, and shelter were sought, and the mental health of the individual under conditions of stress was a matter of research investigation. Diseases indigenous to tropical, sub-tropical, temperate, and polar climates were also being studied. The primary center of all naval medical research is the Naval Medical Research Institute at Bethesda, Maryland. Other medical research activities included: the Naval School of Aviation Medicine and Research at Pensacola, Florida; the Medical Department of the Naval Air Material Center, Philadelphia; the Naval Medical Research Laboratory at the Submarine Base, New London; the Medical Field Research Laboratory at Camp Lejeune, North Carolina; and the naval research units at Cairo, Egypt; Dublin, Georgia; and Berkeley, California, where agents of disease in those environments were being studied.

Although research and development at industrial concerns were greatly reduced at the close of World War II, the bureaus continued to augment the efforts of their laboratories whenever possible through contracts with industrial laboratories. Together, these two programs assured the Navy of a constant flow of the latest engineering developments.

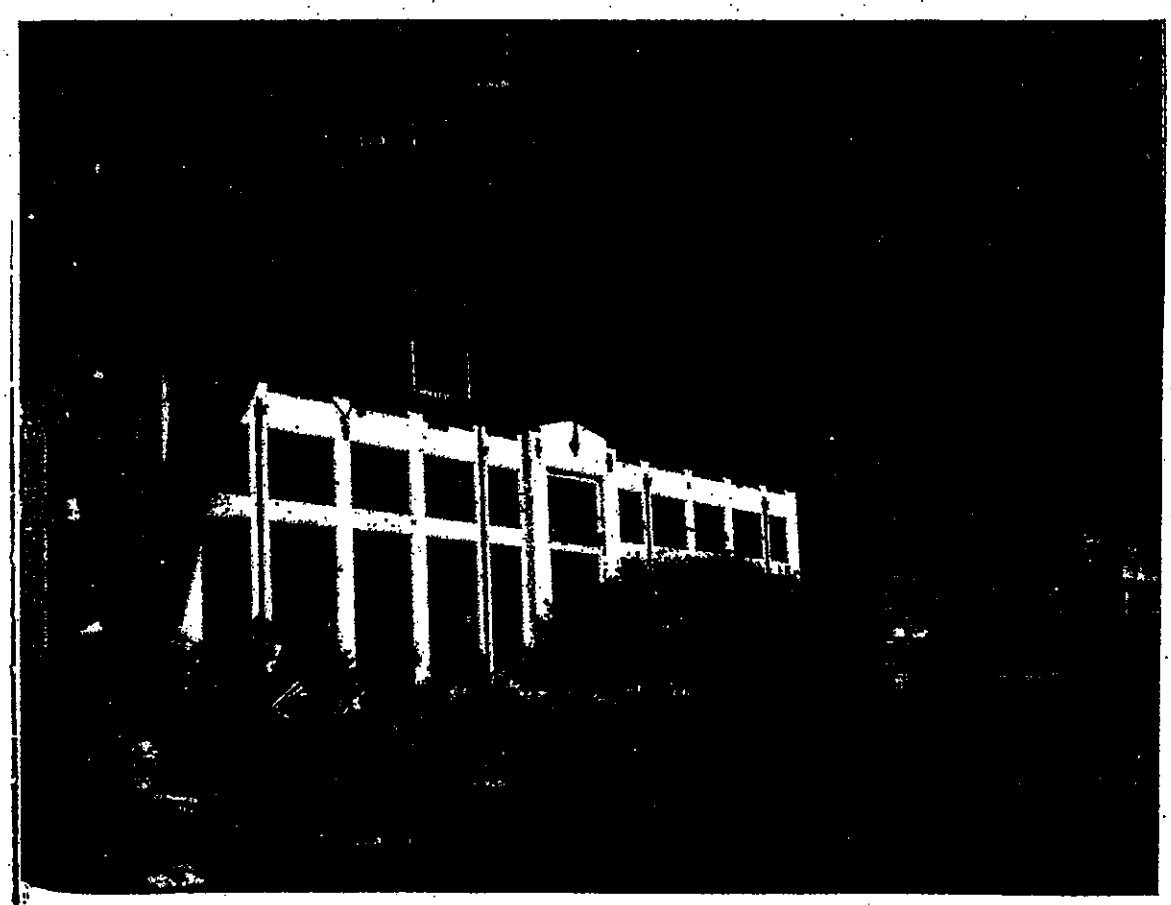
Notwithstanding the technical and engineering development resources represented by these laboratories and contracts with industrial concerns, naval leaders realized that these resources, alone, were not enough to assure the long-range technical progress demanded by modern naval warfare. Even as they knew that the continued development of new weapons, equipments, and materials was of vital im-

portance, they were fully cognizant of the fact that the Navy could never again leave to chance and fortunate circumstance the discovery of the knowledge upon which these developments would depend. Consequently, the Navy embarked on a program in the basic sciences which was to become the technical foundation for the Navy's post-war research and development effort.

Office of Naval Research

Almost three months before Hiroshima, Secretary Forrestal established the Office of Research and Inventions to assure the Navy a well-coordinated research effort in every field of basic science. Renamed and given statutory permanence by Congress in August 1946, the Office of Naval Research was charged with planning and conducting research in conjunction with and support of the extensive applied research and engineering development programs of the Navy. Its establishment was described by Secretary Forrestal as "a Navy Department insurance investment in permanent research . . . expected to provide a revolving fund of progress in research, such as that which has made possible such spectacular developments as the atom bomb, radar rockets, jet planes, and penicillin."

Since the principal source of fundamental scientific knowledge has been, traditionally, the university research laboratory, and the experience and lessons of World War II demanded a mechanism whereby university scientists could



LABORATORIES OF THE OFFICE OF NAVAL RESEARCH
The Office of Naval Research is the coordinating agency for the Navy's research projects.

continue their participation in the solution of the Navy's most difficult problems, the office of Naval Research established what was to become the largest peacetime research program ever supported by a federal agency at educational and non-profit institutions. Through this program the Office of Naval Research set an example in the field of government sponsored research. In the best naval tradition, this successful merging of what had once been considered the incompatible interests of the military and scientific communities represented another "first" of which the Navy could be justly proud.

In the years immediately following its establishment, the contract research program of the Office of Naval Research forwarded the search for new knowledge in those fields of science and engineering vital to naval needs and national security. Nuclear physics, chemistry, electronics, physics, hydrodynamics, aerodynamics, oceanography, mathematics, propulsion, physiology, microbiology, and psychophysiology were but a few of the fields in which the Nation's leading scientists were conducting research for the Navy at virtually every outstanding scientific laboratory in the country.

The far-reaching significance of this program to the Nation's long-term technical strength was incalculable. The country's reservoir of fundamental knowledge, badly depleted by wartime exploitation and application, was being replenished. Formerly dependent upon European research centers for the fundamental advances in science upon which her application and development could be based, the United States was moving toward a scientific maturity which would render it technically independent of the limitations imposed by the wartime ravishment of European scientific culture and the later denial of its remains by iron curtain policies.

TEMPERATURE CHAMBER
Scientists prepare for an experiment in cold-weather clothing at the Naval Research Laboratory.

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For this reason, in addition to providing resh approaches to naval problems, and the aw material of knowledge to make these approaches possible, the Office of Naval Research as making other contributions to the Nation's cientific stature. Through its research programs thousands of graduate students were enabled to obtain advanced degrees by participating in important research projects. Many of he complex and expensive research tools eeded for modern research were provided. Nuclear accelerators, special facilities for low emperature physics, newly developed electronic computers, small supersonic wind tunels, and a host of less glamorous but equally important scientific instruments were added to he Nation's technical arsenal.

A discussion of the Navy-wide character of ONR's research program would not be complete without mentioning the work conducted in its own laboratories. Under the Office of Naval Research, the Naval Research Laboratory continued to contribute numerous scientific and engineering advances resulting from research in a number of the fields of the physical sciences and engineering development. As in the past, part of its program was conducted at the specific request and with the direct support of the bureaus. In providing these services to the bureaus, the laboratory was in a most advantageous position to direct the remaining part of its effort into those areas of research and development that gave promise of meeting immediate and anticipated operational needs of the Fleet.

The Special Devices Center, which during the War had been a part of the Bureau of Aeronautics, was conducting a program devoted to the development of special training devices, mass training techniques, and the introduction of the human factor into the design and development of new equipment. In this way it provided the training agencies of the Navy with the equipments they required to successfully conduct their respective missions.

This, in 1950, was the structure carefully conceived and built by the Navy to foresee its every technical need; a productive technological organization of its own, supported by the most talented scientific minds in the country. It remained but for the advent of Korea, the resulting defense effort, and ever increasing international tensions, to prove how accurately the architects of this structure had predicted and planned for the requirements which would result from war and threats of war.

RESEARCH AND THE CURRENT DEFENSE EFFORT

hange in Emphasis

The Korean conflict demanded that the back- g of engineering developments and scientific scoveries be transformed quickly into new d improved weapons, equipments, and oper- ing techniques. This accelerated need for erational readiness brought about Navy-wide forts to redefine the responsibilities and in- rests of each of its major research and devel- ment activities, in order that the technical sources of each might be exploited to maxi- um advantage.

Changes in program emphasis in the Navy's laboratories were quickly effected to correspond ith the responsibilities of their parent bu- aus. With naval procurement again in full ing, many of the developments that had al- ady resulted from their efforts were incorporated into items being produced to further improve the effectiveness of the fleet. Other development efforts were expanded, based on the results of previously conducted applied research projects, and applied research programs themselves were reoriented to give maximum support to the most urgent operational needs.

Closely integrated with expanded programs at industrial laboratories, these efforts have resulted in a constant flow of new equipments and equipment components into every phase of naval operations.

With the shifting emphasis in bureau programs, it was only natural that the programs of the Office of Naval Research, too, should undergo significant changes. On the fundamental premise that a condition of national emergency could be expected to continue for a long

time, it was decided that the program being supported in the basic sciences would be reoriented but maintained at what was then its current level of support; that every effort would be made to identify research findings as quickly as possible for immediate exploitation; and that every effort would be made to identify and support other areas and programs giving maximum promise of significant applications at some future time.

As in 1940, the military services were again faced with the necessity of turning to the universities for help in solving their applied research problems, and the Office of Naval Research was especially equipped to carry out the task of developing patterns and operations that would enable the scientists in academic institutions to exert a really significant influence on the Navy's applied programs.

Many of these scientists, whose respect for the Navy and interest in naval problems were a direct result of the continuing basic research program of the Office of Naval Research, were eager to participate in the rapidly expanding military research effort. Special studies were conducted by selected teams of scientists, engineers, and naval personnel, of broad basic warfare problems and all courses of action showing promise of eventual solution. Special groups were established to study and evaluate Navy programs in given technical areas. The services of a selected group of university scientists were made available to one of the Navy's largest laboratories for a period of approximately three months; and laboratories were established at universities, concerned with conducting research in broad areas of warfare. Thus the Office of Naval Research carried out the monumental task of acquainting the nation's scientists with the Navy's most perplexing operational problems.

Many of these efforts to bring the nation's scientific talent to bear on military problems were undertaken jointly with the other services. Ultimately, the Office of Naval Research was assigned responsibility for the support and monitorship of Joint Army-Navy-Air Force projects being conducted in a number of our larger academic institutions.

Long-range Results

These various efforts had a number of effects other than the improved content and quality of the Navy's research and development programs. First, they helped the Navy as a whole to take advantage of the reservoir of scientists, engineers, and technical resources available to it. Second, they helped the Office of Naval Research to become even more intimately acquainted with the problems of other naval research activities and the forces afloat; thereby increasing ONR's ability to revamp its own programs to meet more immediate naval needs. Fourth, the manner in which these efforts were carried out assured the Navy of the necessary interest and qualified personnel to carry out resulting programs.

The expansion of ONR's applied research program and the reorientation of its basic research program, coupled with increased responsibilities for projects that were Navy-wide or interservice in character, has resulted in an effort which gives maximum support to the research and development efforts of the bureaus and other offices of the Navy, and contributes an ever increasing number of new scientific ideas and engineering principles to future naval operations.

Guided by the requirements and objectives established by the Office of the Chief of Naval Operations, the Navy's current programs represent the result of a continual process of planning which includes consideration of such factors as: the operational responsibilities which the Navy as a whole will be expected to meet; known deficiencies in weapons, equipments, and operating techniques; estimates of the fighting capabilities and technical capacities of a potential enemy; tactical determinations as to the technical progress needed to achieve and assure continued naval supremacy; and the programs already in existence which give promise of continually meeting current and future needs. Through evaluation of these factors the Navy then determines how much it can invest in its technical future without jeopardizing its day-to-day combat effectiveness and current state of operational readiness.

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In the final analysis it is the Navy's operating sponsibilities that determine the character of s research and development effort. To gather more complete knowledge of these responsilities is to understand more fully the breadth nd scope of the Navy's technical interests. To isualize a vast technical organization respon- ible for maintaining weapons superiority and perating competence, on a world-wide basis, n every field of military endeavor is to appre- iate the stake which the Navy has in the Nation's technical future. To associate intimately with the problems encountered in only one small phase of naval operations is to grasp the importance of even the smallest research project. To sense the gravity of our position in international affairs and the ever present threat to our national security is to gain a glimpse of the struggle going on in our laboratories to keep the Navy and the Nation ever ahead in the race for international technical superiority.

Exhibit 6

VOL. XVII *NO. 1*

UNITED STATES NAVAL MEDICAL BULLETIN

PUBLISHED FOR THE

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COMMANDER H. W. SMITH, MEDICAL CORPS, U. S. NAVY
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LIEUTENANT COMMANDER W. M. KERR, MEDICAL CORPS, U. S. NAVY

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(MONTHLY)

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

THE DIVISION OF PREVENTIVE MEDICINE.

Lieut. Commander R. F. Jones, Medical Corps, United States Navy, in charge.

Notes on Preventive Medicine for Medical Officers, United States Navy.

INSTRUCTIONS TO MEDICAL OFFICERS.

OCCUPATION HAZARDS AND DIAGNOSTIC SIGNS: A GUIDE TO IMPAIRMENTS TO BE LOOKED FOR IN HAZARDOUS OCCUPATIONS.

By Louis I. Dublin, Ph. D., Statistician Metropolitan Life Insurance Co., and Philip Leiboff.

INTRODUCTION.

Many occupations have injurious effects on the physical condition of those engaged in them. The health of those who work with the poisons, such as lead, arsenic, mercury, picric acid, etc., or those who are exposed for long periods to dust, heat, humidity, or to the infectious materials, etc., may be impaired seriously as the result of their work. The occupation is now recognized as of the very first importance as a factor in the causation of disability and even of death. Doctor Edsall has shown that in his clinic at the Massachusetts General Hospital many of the conditions for which treatment is sought by men of working ages are the effects of occupations.[1] Other industrial clinics are reporting similar results. With their attention directed to occupation as a possible factor, industrial physicians are able to diagnose a great many obscure cases which previously had puzzled even the most competent clinicians. In this way they discover a great many more cases of disease of occupational origin than had before been thought possible. Thus, in 1917 about 150 cases of lead poisoning were discovered at the Massachusetts General Hospital, which are more than were recorded by this clinic during the five-year period prior to the adoption of the more intensive methods of study. It is generally recognized that patients come to physicians with pains and complaints of an indefinite char-

[1] See Monthly Labor Review of the U. S. Bureau of Labor Statistics, December, 1917, p. 169–185.

acter, and it is only when consideration is given to the occupation and its possible effects that many of these cases are cleared up.

The medical examiner should, therefore, be very careful to see if any of the usual diagnostic signs of poisoning, dust, heat, or other hazards which are known to be inherent in occupations are in evidence among their patients where no other explanation of the case is readily available. In the case of those exposed to lead, such as employees of storage-battery plants, white-lead workers, paint mixers, painters, etc., the blue line on the gum, the pale, sallow appearance, and the trembling fingers are significant as indications of chronic lead poisoning, and the physician should look for these signs. Physical symptoms and conditions which ordinarily might be passed by in this way become very important if they point to the possible effect of the occupation.

This article has been prepared to aid physicians in general practice, industrial hygienists, safety engineers, and others who come into close professional contact with those who are engaged in industrial processes. Nine major hazards of employment are listed, namely, abnormalities of temperature; compressed air; dampness; dust; extreme light; infections; poor illumination; repeated motion, pressure, or shock; and the poisons. A separate section is devoted to a discussion of skin irritants. Long exposure to any of these will usually leave definite physical signs which the medical examiner can discover if he will look for them. To aid him in detecting the hazards and their effects on the worker, two lists are presented. The first consists of the more common hazardous occupations, arranged alphabetically; the second consists of hazards, together with their effects or symptoms, as well as the occupations affected. After each occupation in the first list is a reference in code to the particular hazard in the second list. The capital letters after each occupation, "A," "B," "C," etc., refer to the general hazard. The Arabic numerals signify the particular hazard, as "D1," inorganic dust; "D2," organic dust.

The following example will show how this guide may be of value to the general practitioner: A man, who works in a garage, suffering from continuous headaches, visits his physician. The latter can find no cause for the patient's illness. The patient shows no signs of disease other than the subjective symptoms which he describes. Perhaps the physician will recommend an examination of the subject's eyes, ears, and sinuses, which will prove negative. A puzzling diagnosis such as this becomes very simple when the occupation is ascertained and this guide is utilized. Alongside of "Garage workers" in the "Alphabetical list of hazardous occupations," the physician finds the symbols J 16, 25. "J" represents the hazard poisons and "16, 25" the particular poisons—carbon monoxide and gasoline,

respectively. Upon looking up the symptoms of these poisons in the second list he finds that both produce headache when inhaled in small quantities. In such a case the effective remedy lies in the removal of the etiological factor—the two poisons.

The following procedure is therefore recommended: The medical examiner or physician should ascertain the occupation of the applicant. He should then look for it in the "Alphabetical list of hazardous occupations." If found there, it is possible that the person has been exposed to and is possibly suffering from the effects of some hazard of the occupation. The numerals will indicate the particular hazards of the occupation. The physician should then make special effort to discover the symptoms or signs referred to in the second list. By this means he can readily determine whether the person examined is in fact suffering from the effect of his occupation. His examination is in this way made more illuminating. Physicians, not specialists in occupational hygiene, can thus learn to detect the effects of industry and, conversely, can eliminate the occupation as the cause when certain symptoms are observed which do not fit the usually observed effects of the occupation.

Medical examiners should remember that it is often necessary to keep in mind not only the present occupation but the former one as well. Persons suffering from certain ailments may no longer be engaged in the industry which was originally responsible for their condition. But careful inquiry into their occupational history will sometimes result in the recording of an occupation the effects of which are clearly those from which the patient is suffering. The medical profession must give occupational findings greater weight in forming their judgments regarding physical conditions and in diagnosing and treating disease.

ALPHABETICAL LIST OF HAZARDOUS OCCUPATIONS.

Acetylene makers, D 1, J 4, 16, 43.
Acid dippers, C, J 10, 22, 26, 37, 48.
Acid finishers (glass), J 26, 28, 48.
Acid makers. *See* particular acid.
Acid mixers, J 26, 37, 48.
Acid recoverers, J 26, 37, 48.
Acid transporters, J 26, 37, 48.
Airplane-wing varnishers, J 50. *See also* Varnishers.
Alcohol distillery workers, J 5, 6.
Aldehyde pumpmen, J 1, 30.
Alkali salt makers, C, J 14, 18, 26, 46, 47.
Amber workers, J 28.
Ammonium salts makers, A 1, J 4, 15, 22, 26, 48.
Ammonium sulphate makers, J 48.
Aniline dye makers. *See* Dye makers.
Aniline makers, J 7, 10, 12, 26, 34, 37.
Animal hair dressers. *See* Hair workers.
Animal handlers, F 1, 3.
Annealers, A 1.
Antimony extractors (refiners), A 1, J 8.
Antimony fluoride extractors, J 27.
Antipyrin makers, J 31, 40.
Arsenic roasters, A 1, J 9.
Art-glass workers, J 5, 11, 27, 28, 30, 52.
Artificial flower makers, H, J 9, 21, 28, 29, 30.

Artificial ice makers, A 2, C, J 4.
Artificial leather makers, J 7, 9, 12, 37, 48.
Artificial manure makers. *See* Fertilizer makers.
Artificial silk makers, C, J 4, 5, 15, 30, 47, 50.
Asbestos workers, D 1.
Asphalt testers, J 15.
Auto painters, C. *See also* Painters.

Babbitters, J 28.
Bakelite makers, J 39.
Bakers, A 2, D 2, J 16.
Balloon (toy) fillers, J 10.
Barbers, H.
Bar-mill workers (iron and steel), A 1.
Basic slag (artificial manure) workers, D 1.
Batch makers (glass works). *See* Glass mixers.
Batch makers (rubber works). *See* Compounders (rubber).
Baters (tannery), C, F 1.
Battery (dry) makers, D 1, J 5, 10, 12, 21, 26, 28, 29, 49.
Battery (storage) makers. *See* Storage battery makers.
Beamers (textile), D 2.
Beamhouse workers (tannery), C, F 1.
Beatermen (paper and pulp), C, J 18.
Bed rubbers (marble and stone), D 1.
Bench molders (foundry), D 1, J 13, 28.
Benzol stillmen, A 1, J 12.
Bessemer-converter workers (iron and steel), A 1.
Beta still operators (beta naphthol), A 1, J 48.
Bevellers, D 1.
Bicyclists, H.
Billet mill workers (iron and steel), A 1.
Bisque-kiln workers, A 1, D 1, J 16.
Blacksmiths A 1, E, H, J 14, 16, 22, 28.
Blast-furnace workers, A 1, J 22, 46, 47.
Bleachers, A 2, C, J 17, 18, 21, 27, 37, 46.
Bleachers (cloth), A 2, C.
Bleachery dryers, A 2, C.
Blockers (felt hat), C, J 16.
Blooders (tannery), J 28.
Blooming-mill workers (iron and steel), A 1.
Blowers (felt hat), D 2, J 29.
Blowers (glass manufacturing). *See* Glass blowers.
Blowers-out (zinc smelting), A 1, J 13.
Bluers (revolvers), A 1.
Boiler-room workers, A 1, J 14, 16.
Boiler washers, C.
Bone-black makers, J 4, 42.
Bone renderers, J 3.
Bone workers, D 1.
Bookbinders, J 9, 28, 30.
Bottle-cap makers, J 28.
Brass founders, A 1, J 8, 9, 13, 14, 16, 28, 42, 46.
Brass polishers, J 28.
Braziers, A 1, J 13, 28.
Brewers, A 2, C, J 14.
Brick burners, A 1, J 14, 28.
Brickmakers, A 1, C, D 1, F 2, J 28, 46.
Briquet makers, J 49.
Bronzers, D 1, J 4, 5, 9, 10, 11, 12, 13, 25, 28, 29, 30, 47.
Broom makers D 2, J 18, 46.
Browners (gun barrels), J 22, 28, 29, 38.
Brushers (felt hat), D 2, J 29.
Brush makers, D 2, F 1, J 28, 30, 49.
Buffers, D 1, 2, G.
Buffers (rubber), J 5, 11, 28.
Burners (enameling), A 1, J 28.
Burnishers (iron and steel), G, J 8, 48.
Burnishers (rifle barrels), J 8.
Burrers (needles), D 1.
Burr filers, D 1.
Butchers, A 2, F 1, 3.
Button makers, D 1, 2.

Cable makers, J 28.
Cable splicers, C, J 16, 28, 47, 52.
Caisson workers, A 2, B, C, G, J 14.
Calenderers (rubber), A 2, D 1.
Calico printers, A 2, C, J 7, 8, 9, 16, 18, 21, 22, 26, 28, 30, 39, 48, 52.
Camphor makers, J 26, 52.
Candle (colored) makers, J 9 21.
Candy makers A 2 C.
Canners, A 2, C, F 3, J 28.
Cap loaders, J 29.
Cappers (window glass), A 1.
Carbide makers, A 1, D 1, J 16.
Carbolic acid makers, J 12, 26, 46, 48.

Carbon brush makers, D 1.
Carbon dioxide makers, J 14.
Carbon disulphide makers, J 15.
Carbonizers (shoddy), D 2, J 10, 26, 48.
Carborundum workers, A 1, D 1.
Carders (textile), D 2.
Card grinders (textile), D 1, 2.
Carpenters, H.
Carpet makers, D 2, F 1, J 9.
Carroters (felt hats), J 9, 29, 37.
Cartridge cup washers, C.
Cartridge dippers, J 26, 37, 48.
Cartridge felt and wad makers, C.
Cartridge makers, J 28, 29.
Cartridge shot shell paraffin dippers, A 2, C.
Case hardeners, A 1, J 22.
Casters (brass foundry). *See* Brass founders.
Casters (iron and steel), A 1.
Casting cleaners (foundry), D 1. *See also* Acid dippers.
Cast scrubbers (electroplaters), J 11, 12.
Catchers (iron and steel), A 1.
Cattle salesmen, F 1.
Celluloid makers, J 1, 5, 11, 15, 16, 22, 28, 30, 37, 47, 48.
Celluloid polishers, D 2.
Celluloid workers, D 2.
Cementers (rubber shoes), J 11, 12, 15, 30, 52.
Cement mixers (rubber), J 11, 12, 15.
Cement workers, A 1, D 1.
Chambermen (sulphuric acid), J 46, 48.
Charcoal burners, J 14, 16.
Charcoal workers (sugar refining), A 2, C, D 1.
Chargers (smelting), A 1, D 1.
Chargers (zinc smelting), A 1, D 1, J 9, 13, 16, 28, 46.
Chasers (steel), D 1.
Chauffeurs, H, J 25.
Chimney sweepers, D 1, J 16, 49.
Chippers, D 1.
Chloride of lime makers, J 17, 18.
Chlorine makers (electrolytic), J 18, 29.
Chloroform makers, J 17.
Chromium workers, J 21.
Cigar makers, D 2, H.
Clay and bisque makers (pottery), A 2, C, D 1.
Clay-plug makers (pottery), C, D 1.
Clay-products workers. *See* Pottery workers.
Clerks, H.
Cloth preparers, C. *See also* Bleachers.
Coal miners. *See* Miners.
Coal-tar workers, J 7, 12, 16, 39.
Cobblers, D 2, F 1, H.
Coke-oven workers, A 1, J 4, 12, 16, 49.
Cold-storage-plant workers, A 2.
Color makers, A 1, D 1, J 8, 9, 12, 21, 28, 29.
Colored-paper workers, J 9.
Colorers (white) of shoes, J 28.
Comb makers (celluloid), D 2.
Compositors, D 1, G, H, J 7, 8, 11, 28.
Compounders (rubber), D 1, J 7, 8, 9, 11, 12, 21.
Concentrating-mill workers (lead and zinc), C, D 1, J 28.
Coners (felt hats), D 2, J 29.
Confectioners. *See* Candy makers.
Construction camp workers, F 2.
Cooks, A 2.
Copper founders, J 9.
Copper miners. *See* Miners.
Copper smelters, A 1, J 9, 16, 46.
Cord makers, D 2, J 49.
Core makers, A 1, D 1, J 13, 16.
Cork workers, D 2.
Cotton-mill workers, C, D 2.
Cotton twisters, D 2, H.
Cranemen (glass industry), A 1.
Cranemen (iron and steel), A 1.
Creosoting plant workers, C.
Crucible mixers, D 1.
Crucible-steel department employees, A 1.
Crushermen (clay and stone), D 1.
Cupola men (foundries), A 1.
Curers, vapor (rubber). *See* Vulcanizers.
Curriers (tannery), D 2, F 1, J 9, 11.
Cut-glass workers, D 1, J 9, 28.
Cutlery makers, D 1, J 5, 28.
Cyanamid makers, A 1, D 1.

Dancers, H.
Decorators (pottery), J 9, 11, 12, 28, 52.

Paper makers, A 2, C. *See also* particular occupation.
Paraffin workers, J 15, 38, 49.
Patent-leather makers, A 2, J 5, 16, 28, 30, 48, 52.
Pavers, A 1, H, J 49.
Pencil (colored) makers, J 7, 9, 21.
Perfume makers, J 23, 30, 34.
Petroleum refiners, A 1, C, J 25, 26, 28, 38, 46, 47, 48, 49.
Phenol makers. *See* Carbolic-acid makers.
Phosgene makers, J 16, 18, 41.
Phosphate-mill workers, A 2, C, D 1, J 42. *See also* Fertilizer makers.
Phosphor-bronze workers, J 42.
Phosphorus-compounds makers, J 42.
Phosphorus-evaporating-machine operators, A 2, C, J 48.
Phosphorus extractors, J 42, 43.
Phosphorus (red) makers, J 43.
Photo-engravers, J 12, 21, 30, 37.
Photographers, E, G, J 30, 44.
Photographic workers, J 7, 12, 18, 21, 22, 29.
Photograph retouchers, J 28.
Picklers, C, J 10, 22, 26, 37, 48.
Picric-acid makers, J 37, 39, 44, 48.
Pigment makers. *See* Color makers.
Pipe fitters, J 28. *See also* liquid piped.
Pitch workers, J 9.
Pit molders (foundry), A 1, D 1.
Planer men (stone, metal), D 1.
Plasterers, C, D 1.
Plaster of Paris workers, D 1.
Platers. *See* Electroplaters.
Plumbers, J 28. *See also* substance manufactured.
Pneumatic-tool workers, D 1, H.
Polishers, D 1, J 5, 25, 28, 30.
Polishers (furniture). *See* Furniture polishers.
Porcelain makers. *See* Pottery.
Porters, H.
Pot fillers (glass), A 1.
Pot lifters (iron and steel), A 1.
Pot pullers (foundry), A 1.
Pot-room workers (aluminum foundry; carbide plant), A 1.
Pot setters, A 1.
Pottery workers, A 1, C, D 1, J 9, 14, 16, 26, 28, 46. *See also* particular occupation.
Pouncers (felt hats), D 1, 2.
Pourers (brass foundry), A 1, J 13.
Preparers (tannery), C, F 1, 3.
Pressers, H, J 16.
Pressman (oil refining), C.
Pressmen (printers), D 1.
Pressroom workers (rubber), A 2, J 7, 8, 9, 11, 12, 21.
Primers (explosives), J 29.
Printers, D 1, J 7, 8, 9, 11, 28, 52.
Puddlers (iron and steel), A 1, E.
Pullers-out (felt hats), C.
Pulp-mill employees, C. *See also* particular occupation.
Putty makers, D 1, J 11, 15, 28.
Putty polishers (glass), D 1, J 28.
Pyrites burners, A 1, D 1, J 9, 46, 47.
Pyroxylin makers. *See* Guncotton.

Quarrymen, D 1, F 2.

Rag workers, D 2, F 3.
Reclaimers (rubber), J 7, 12, 15, 26, 28, 48.
Red-lead workers, J 28.
Refiners (metals), A 1, J 9, 10, 16, 28, 29, 37, 46. *See* also particular metal.
Refiners (sugar). *See* Sugar refiners.
Refrigerating-plant workers, A 2, C, J 4.
Riveters, H, J 28.
Roller coverers (cotton mills), C, D 2.
Rollers (metals), A 1.
Roll setters (iron and steel), A 1.
Roll wrenchers (iron and steel), A 1.
Roofers, A 2, J 28, 49.
Roofing-paper workers, J 49.
Rope makers, D 2.
Roughers (iron and steel), A 1.
Rubber-glove makers, J 11.
Rubber-substitute makers, J 45.
Rubber-tire builders, J 9, 11, 12, 21.
Rubber washers, J 9, 11, 12, 21.
Rubber workers, A 2, D 1, 2, J 7, 8, 9, 11, 12, 21, 25, 26, 28, 39, 46, 52. *See also* particular occupation.

Sagger makers, C, D 1, J 28.
Sailors, A 2, H.
Salt extractors (Coke-oven by-products, J 4, 48.
Salt preparers, A 2, C, D 1.
Sand blasters, D 1.
Sand cutters, D 1.

Table hands (tannery), C, F 1.
Table operators (iron and steel), A 1.
Table turners (enameling), A 2, D 1, J 28.
Tailors, H.
Takers-down (glass), A 1.
Tallow refiners, F 3, J 3, 15, 48.
Tank men, C.
Tannery workers, C, F 1, 3, J 7, 9, 11, 17, 21, 22, 28, 46, 47, 48.
Tapers (airplanes), J 50.
Tappers (smelting), A 1.
Tar workers, J 49.
Taxidermists, D 2, F 1, J 9, 29.
Teazers (glass), A 1, J 16.
Telegraphers, H.
Telephone linemen (trench work), C.
Temperers, A 1, C, J 16, 22, 28, 38, 48.
Textile-comb makers, D 1.
Textile printers. *See* Calico printers.
Textile workers, A 2, C, D 2. *See also* particular occupation.
Thermometer makers, J 29.
Thread glazers, A 2, C.
Tile makers, A 2, C, D 1, J 28.
Tin-foil makers, A 1, J 28.
Tinners, A 1, C, J 3, 4, 9, 10, 26, 28.
Tin-plate mill workers. *See* Iron and steel workers.
Tire builders. *See* Rubber-tire makers.
Tobacco moisteners, C.
Tobacco rollers, D 2.
Tobacco workers, D 2.
Tongsmen (iron and steel), A 1.
Toolmakers, D 1.
Top fillers (foundry), A 1, D 1.
Towermen (sulphuric acid), J 10, 37, 46, 48.
Toy makers, J 5, 9, 28.
Transfer workers (pottery), J 28, 52.
Transporters of hides and wool, F 1.
Treaders (rubber), J 12.
Tree sprayers. *See* Sprayers (trees).
Trench diggers, F 2.
Tube makers (glass), A 1.
Tubulators (incandescent lamps), J 16.
Tumbling barrel workers, D 1.
Tunnel workers, B, F 2, G.
Turners-out (glass), A 1.
Turpentine extractors, C, J 52.
Type cleaners, J 11, 30.
Type founders, J 28.
Typesetters, J 28.
Typists, H.

Upholsterers, D 2, J 30.

Vapor curers. *See* Vulcanizers.
Varnish boilers, J 3.
Varnish makers, A 2, J 1, 3, 4, 11, 12, 30, 52.
Vatmen, C.
Velvet makers, C, J 9.
Veterinarians, F 1, 3.
Vignetters, J 26.
Vinegar workers, J 1.
Vinters, J 14.
Vulcanizers, A 2, C, J 7, 8, 11, 12, 15, 21, 30, 45.
Vulcanizers (steam), A 2, C.

Wall-paper printers, A 2, C, J 9, 21, 28.
Warming-house employees (guncotton), A 2.
Washers, C.
Washers (rubber), C.
Washwomen, C, H.
Watchmakers, G, H.
Water gilders, J 29.
Waterproof-cloth makers, J 25.
Weavers, D 2, H.
Weighers, D 1, 2.
Welders, A 1, E, J 13, 28.
White-lead workers, J 14, 28.
Wire drawers, J 9, 48.
Wirers (incandescent lamps), J 5.
Wood-alcohol distillers, J 30.
Wood-last scourers (shoes), D 2.
Wood preservers, J 9, 39, 49.
Wood stainers, J 21, 28.
Woodworkers, D 2, J 25, 30.
Wool carders, D 2, F 1.
Wool scourers, A 2, C.
Wool spinners, D 2, F 1.
Wool workers, D 2, F 1. *See also* particular occupation.
Wringers (guncotton), J 37.

X-ray workers, E.

Yeast makers, J 14.

Zinc-chloride makers, J 10, 18, 26.
Zinc-electrode makers, J 29.
Zinc miners, J 9. *See also* Miners.
Zinc smelters, A 1, J 13, 16, 28, 46.

LIST OF HAZARDS, SYMPTOMS, OCCUPATIONS EXPOSED, AND PREVENTION.

A. Abnormalities of Temperature.

The primary physiological effect of abnormal temperatures is the disturbance of the heat-regulating system of the body. Heat dilates the blood vessels on the surface of the body, increasing the supply of blood in this region. Cold, on the other hand, constricts the blood vessels, causing a diminished blood supply on the body surface. Continuous abrupt changes from one extreme of temperature to another may cause serious congestion of the internal organs, the heat-regulating system of the body not being capable of adapting itself to sudden variations. It is in this way that a cold draft, which causes a sudden variation of the temperature, may produce neuralgia, paralysis, and respiratory diseases. Extremes of temperature may produce pathological changes by direct action. Thus, extreme dry heat will cause conjunctivitis, cataract, and the familiar sunburn. Extreme cold may cause frostbite and eczema. With the above data in mind, abnormalities of temperature have been classified under only two headings, namely, "Sudden variations of temperature" and "Extreme dry heat." Extreme cold has not been listed as a distinct hazard, because a temperature so low as to cause the direct effects mentioned above is rarely met in industry. It is evident that the occupations listed in the division "Extreme dry heat" are exposed not only to the danger of the direct action of the high temperatures but also to the hazard "Sudden variations of temperature."

The prevention of disease due to exposure to extremes of temperature consists, obviously, in the avoidance of sudden variations of temperature. Drafts are particularly hazardous, and may be practically eliminated by the use of vestibule and storm doors. Workers in cold processes should keep active and avoid chill. The hot-process worker should allow his body to cool off gradually after completion of the day's work. He should carefully regulate his diet, drinking plenty of water and avoiding meats. As direct preventive measures for the effects of extreme heat, it is advisable to make use of shields, helmets, goggles, water-cooled furnace doors, exhaust systems, cold air, fans, etc.

A. Abnormalities of Temperatures.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
1. Extreme dry heat.	Anemia, general debility, catarrh, stiff joints, cramps, lumbago, Bright's disease, skin eruptions, premature old age, cataracts, retinitis, conjunctivitis.	Ammonium salts makers; suncalers; antimony extractors (refiners); arsenic roasters; bar-mill workers (iron and steel); benzol-stillmen; Bessemer-converter workers (iron and steel); beta-still operators (beta naphthol); billet-mill workers (iron and steel); bisque-kiln workers; blacksmiths; blast-furnace workers; blooming-mill workers (iron and steel); blowers-out (zinc smelting); bluers (revolvers); boiler-room workers; brass founders; braziers; brick burners; brick makers; burners (enameling); cappers (window glass); carbide makers; carborundum makers; case hardeners; casters (iron and steel); catchers (iron and steel); cement workers; chargers (smelting); chargers (zinc smelting); coke-oven workers; color makers; copper smelters; core makers; cranemen (glass industry); cranemen (iron and steel); crucible-steel-department employees; cupola men (foundries); cyanamid makers; dressers (glass); drop forgers; enamelers; flatteners (glass); floor molders (foundry); forgemen; foundry workers; furnace workers; gatherers (glass); glass blowers; glass-furnace workers; graphite workers; hardeners (metals); hot-rod rollers (iron and steel); iron and steel workers (all departments); junk (metal) refiners; kiln tenders; layer pullers (glass); leadfoil makers; lead smelters; leer tenders (glass) levermen (iron and steel); lifters-over (glass); luters (zinc smelting); marblers (glass); melters (foundry; glass); mercury smelters; muffle tenders; open-hearth-department workers (iron and steel); pair heaters (tin plate); pavers; petroleum refiners; pit molders (foundry); pot fillers (glass); potlifters (iron and steel); pot pullers (foundry); pot-room workers (aluminum foundry; carbide plant); pot setters; pottery workers; pourers (foundry); puddlers (iron and steel); pyrites burners; refiners (metals); rollers (metals); roll setters (iron and steel); roll wrenchers (iron and steel); roughers (iron and steel); shove-in boys (glass); skimmers (glass); slag-machine tenders (iron and steel); still (coal-tar) cleaners; stillmen (carbolic acid); stillmen operating; stokers; sulphur burners; table operators (iron and steel); takers-down (glass); tappers (smelting); teazers (glass); temperers; tin-foil makers; tinners; tongsmen (iron and steel); topfillers (foundry); tube makers (glass); turners-out (glass); welders; zinc smelters.
2. Sudden variations of temperature.	Congestion of internal organs, catarrh, neuralgic and rheumatic affections, gastro-intestinal and vesical catarrh, pneumonia, Bright's disease.	Artificial-ice makers; bakers; bleachers; brewers; butchers; caisson workers; calenderers (rubber); calico printers; candy makers; canners; cartridge shot shell paraffin dippers; charcoal workers (sugar refining); clay and bisque makers (pottery); cold-storage-plant workers; cooks; digester-house workers (paper and pulp); dresser tenders (textile); drivers; dry cleaners; dryers (felt hats); drying-room workers (miscellaneous); dye makers dyers; electrotypers; extractor operators (soap); fat renderers; felt-hat makers; fishermen; flangers (felt hats); gas (illuminating) workers; glost-kiln workers; glue workers; hothouse workers; ice cream makers; ironers, japan makers; lasters (shoes); laundry workers; linoleum makers; lumbermen; miners; mirror silverers; mixers (rubber); motormen; packing-house employees; paper makers; patent-leather makers, phosphate-mill workers; phosphorus-evaporating machine operators; press-room workers (rubber); refrigerating-plant workers; roofers; rubber workers; sailors; salt preparers; shoe finishers; silver melters; soap makers; spreaders (rubber works); stearic-acid makers; stereotypers; straw-hat makers; sugar refiners; sulphite cooks (pulp mill); table turners (enameling); textile workers; thread glazers; tile makers; varnish makers; vulcanizers; wall paper printers; warming-house employees (guncotton); wool scourers. *See also* occupations exposed to extreme dry heat.

B. Compressed Air.

In building tunnels, laying deep foundations for large buildings, etc., it is necessary for the work to be carried on under increased air pressure in order to prevent the entrance of water into the excavations. The laborer is lowered gradually and at short intervals the

pressure of the air in the compartment is increased. The first sensation of compression is felt on the eardrums, which may be relieved by the act of swallowing. If the air is too quickly compressed hemorrhage may occur. The greater part of the danger of working in compressed air lies in hasty decompression. While under compression the blood and tissue juices dissolve an increased amount of air, the gases of which are released when the pressure is suddenly decreased. The bubbles thus formed cut off the blood supply from various parts of the body by blocking up the capillaries. The symptoms of compressed air illness, the so-called "bends," are the result.

Workers in compressed air must follow strictly the rules governing gradual compression and decompression, especially the latter. It is not advisable for boys and for men over 40 years of age to work under high pressure.

B. Compressed air.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
Compressed air.....	Weakness, vertigo, pains in the back and legs, paralysis of legs and arms, painful constriction of the chest, cerebral hemorrhage and aphasia, coma, subcutaneous hemorrhages, impairment of hearing.	Caisson workers; divers; tunnel workers.

C. DAMPNESS.

The moisture content of the air is very important for the proper adjustment of the physiologic processes of the body. Damp air will prevent the evaporation of moisture from the body and will therefore affect the body temperature. High humidity tends to increase the effects of high temperature. Moist cold air has the effect of undermining the general vitality of the organism, weakening its resistance to diseases of the respiratory passages, and to neuralgic and rheumatic affections. The same effects are noticed among workers around open tanks and vats, who are continuously working in wet clothes. Excessive dampness suggests dry air as a hazard. The latter causes chapped skin and catarrhal conditions. It has not been listed among the hazards because it is not characteristic of any one occupation but is prevalent generally, especially during the winter months.

When dampness is a feature of an industrial process the following precautions should be taken to avoid ill effects:

(1) Provision of exhaust systems wherever steam is generated.

(2) Provision of floors with drain channels to prevent the accumulation of water.

(3) Provision of adequate waterproof clothing, such as rubber boots, rubberized aprons, etc.

Wherever there is dampness special measures should be taken to keep the humidity at its proper percentage. In this connection the wet-bulb thermometer is invaluable in determining the degree of moisture in the air. By circulating the air the effects of high humidity may be mitigated.

C. Dampness.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
Dampness.....	Diseases of the respiratory passages, neuralgic and rheumatic affections.	Acid dippers; alkali-salt makers; artificial-ice makers; artificial-silk makers; auto painters; baters (tannery); beamhouse workers (tanners); beatermen (paper and pulp); bleachers; bleachery dryers; blockers (felt hats); boiler washers; brewers; brickmakers; cable splicers; caisson workers; calico printers; candy makers; canners; cartridge-cup washers; cartridge felt and wad makers; cartridge shot shell paraffin dippers; charcoal workers (sugar refining); clay and bisque makers (pottery); clay-plug makers (pottery); cloth preparers; concentrating-mill workers (lead and zinc); cotton-mill workers; creosoting-plant workers; digester-house workers (paper and pulp); doffers (textile); dresser tenders (textile); drivers; dye makers; dyers; electroplaters; enamelers; explosive workers; extractor operators (soap); felt extractors; felt-hat makers; fertilizer makers; filter-press workers; fishermen; flax spinners; flush tenders (aluminum); galvanizers; glass cutters; glass finishers; glaze dippers (pottery); glove makers (leather preparers); glue workers; grinders (metals); gun-cotton washers; hair workers; ice-cream makers; lasters (shoes); laundry workers; lime pullers (tannery); linoleum makers; masons; match-factory workers; miners; mirror silverers; nickel platers; packing-house employees; paint makers; paper makers; petroleum refiners; phosphate-mill workers; phosphorus-evaporating-machine operators; picklers; plasterers; pottery workers; preparers (tannery); pressmen (oil refining); pullers-out (felt hats); pulp-mill employees; refrigerating-plant workers; roller coverers (cotton mills); sagger makers; salt preparers; screen tenders (pulp mill); sewer workers; shavers (felt hats, fur, tannery); sizers (felt hats); slip makers (pottery); smoothers (glass); soap makers; soda makers; sodium-hydroxide makers; spongers; stamp-mill workers; starters (felt hats); stone cutters (wet process); sugar refiners; sulphite cooks (pulp mill); sumackers (tannery); table hands (tannery); tank men; tannery workers; telephone linemen (trench work); temperers; textile workers; thread glazers; tile makers; tinners; tobacco moisteners; turpentine extractors; vatmen; velvet makers; vulcanizers (steam); wall-paper printers; washers; washers (rubber); wool scourers.

D. Dust.

Dusts have here been divided into two kinds, according to their chemical composition, namely, organic and inorganic. The difference in symptoms listed under each is based on the findings of recent investigators that organic dusts do not cause pulmonary lesions. Dr. H. R. M. Landis [2] has found that wherever fibrosis was present in the lungs of men exposed to organic dust, the latter was always mixed with some form of mineral or metallic dust. Tobacco workers exposed to organic dust for years showed no pulmonary changes other than those found in people living in the city. Mineral and metallic dusts, however, produce fibrosis of the lung tissue, the

[2] See article on "The Pathological and Clinical Manifestations Following the Inhalation of Dust," in The Journal of Industrial Hygiene, July, 1919, pp. 117–139.

extent of which depends on the time of exposure and the particular dust inhaled. Of the inorganic dusts, silica is the most harmful, producing serious pulmonary damage in a comparatively short period of time, while the least harmful are those which produce slight changes and then only after long exposure, for example, lime, coal, etc. The relationship between occupational dust and tuberculosis is rather a doubtful one. Authorities disagree as to the effect of fibrosis on the resisting power to the tubercle bacillus. Dust, by acting as a carrier of the bacilli, may increase their number in the lungs. In this way, men exposed to dust may be in greater danger of contracting turberculosis than others. Dr. H. R. M. Landis claims, however, that in the trades exposed to inorganic dust, mistaken diagnosis of pneumoconiosis swells the mortality statistics for tuberculosis. As a means of avoiding incorrect diagnosis of pneumoconiosis, Roentgen ray examinations of the lungs and sputum analyses are invaluable.

There are four effective methods that may be used to prevent the inhalation of dust generated during industrial processes. No one of these can apply to all conditions, but the particular method to be used must be adapted to the peculiarities of the process.

(1) The use of water to dampen the dust and thus prevent it from rising and filling the atmosphere.

(2) The use of exhaust systems which remove the dust at the point of origin.

(3) The use of inclosing chambers in which the dust-producing processes are confined, being regulated from the outside.

(4) The use of respirators and helmets.

In many cases it may be necessary to combine several of these measures effectively to prevent the inhalation of dust by the worker.

D. Dust.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
1. Inorganic dust....	Cough, dyspnea, pleuritic pains, hemoptysis, clubbed fingers, marked flatness of chest, deficient expansion (unilateral), dullness, diminished resonance, mucous rales, fibrosis, inflammatory condition of eyes, ears, nose, and throat; colds, chronic catarrh of respiratory tract, chronic catarrh of digestive tract, pleurisy, tuberculosis.	Acetylene makers; asbestos workers; basic slag (artificial manure) workers; battery (dry) makers; bed rubbers (marble and stone); bench molders (foundry); bevellers; bisque-kiln workers; bone workers; brickmakers; bronzers; buffers; burrers (needles); burr filers; button makers; calenderers (rubber); carbide makers; carbon-brush makers; carborundum workers; card grinders (textiles); casting cleaners (foundry); cement workers; charcoal workers (sugar refining); chargers (smelting); chargers (zinc smelting); chasers (steel); chimney sweepers; chippers; clay and bisque makers (pottery); clay-plug makers (pottery); color makers; compositors; compounders (rubber); concentrating-mill workers (lead and zinc); core makers; crucible mixers; crushermen (clay and stone); cut-glass workers; cutlery makers; cyanamid makers; diamond cutters; electrotypers; emery-wheel makers; engravers; fertilizer makers; file cutters; filers; flint workers; floor molders (foundry); flue cleaners; foundry workers; glass blowers; glass cutters; glass finishers; glass mixers; glaze mixers (pottery); gold beaters; gold refiners; graphite workers; grinders (metals); gypsum workers; horn workers; jewelers; junk (metal)

D. Dust—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
1. Inorganic dust—Continued.	Cough, dyspnea, pleuritic pains, etc.—Continued.	refiners; lapidaries; lead smelters; lime burners; lime-kiln chargers; lime workers; linoleum makers; lithographers; marble cutters; masons; match-factory workers; metal turners; mica strippers or splitters; mica workers; miners; mixers (rubber); mixing-room workers (miscellaneous); mold breakers (foundry); paint removers; paperhangers; phosphate-mill workers; pit molders (foundry); planer men (stone, metal); plasterers; plaster of Paris workers; pneumatic-tool workers; polishers; pottery workers; pouncers (felt hats); pressmen (printers); printers; putty makers; putty polishers (glass); pyrites burners; quarrymen; rubber workers; sagger makers; salt preparers; sand blasters; sand cutters; sanders; sanding machine operators; sandpaperers (enameling and painting auto bodies, etc.); saw filers; scrapers (foundry); screen workers (lead and zinc smelting); sifters; sintering-plant workers; slate workers; slip makers (pottery); smoothers (glass); spinners (asbestos); stamp-mill workers; statuary workers; stonecutters (dry); stonecutters (wet process); sugar refiners; sulphur burners; table turners (enameling); textile-comb makers; tile makers; tool makers; top fillers (foundry); tumbling-barrel workers; weighers.
2. Organic dust.....	Dryness of nose, throat, and mouth, cough, anaphylaxis, asthma, bronchitis, emphysema, tuberculosis.	Bakers; beamers (textiles); blowers (felt hats); broom makers; brushers (felt hats); brush makers; buffers; button makers; carbonizers (shoddy); carders (textiles); card grinders (textiles); carpet makers; celluloid polishers; celluloid workers; cigar makers; cobblers; comb makers (celluloid); coners (felt hats); cork workers; cotton-mill workers; cotton twisters; curriers (tannery); devil operators (felt hats); doffers (textiles); feather curers; feather workers; felt-hat makers; fiber workers; finishers (leather); flax spinners; flour workers; formers (felt hats); fur carders; fur clippers; fur cutters; fur handlers; fur preparers; fur pullers; glove makers (leather preparers); glue workers; grain-elevator workers; grinders (rubber); gun-cotton pickers; hair workers; harness makers; heel makers (shoe); hemp workers; jute workers; knitting-mill workers; lace makers; lasters (shoes); leather workers; linen workers; match-factory workers; mattress makers; mixers (felt hats); mixing-room workers (miscellaneous); pouncers (felt hats); rag workers; roller coverers (cotton mills); ropemakers; rubber workers; sawmill workers; scourers, wood lasts (shoes); shavers (felt hats, furs, tannery); shaving-brush makers; shoddy workers; shoe-factory operatives; sifters; silk workers; softeners (tannery); spinners (textiles); starch makers; straw-hat makers; taxidermists; textile workers; tobacco rollers; tobacco workers; upholsterers; weavers; weighers; wood-last scourers (shoes); wood workers; wool carders; wool spinners; wool workers.

E. Extreme Light.

Intense light is usually a product of a process associated with heat. Among the different kinds of light included under this heading are the arc light, furnace glare, glowing metal or glass, and X ray. Poor illumination as a hazard is treated under "G. Poor illumination." Continuous exposure to strong light is not only irritating to the conjunctiva, but may also cause a degeneration of the retina and decomposition of the visual purple. Repeated electric flashes of brilliant light have caused severe ophthalmia, retinitis, and even blindness. Glass blowers and steel puddlers, who have to look at a glowing molten mass, are apt to develop cataracts. It seems that the invisible ultra-violet rays and infra-red rays are responsible. The introduction of X rays into the medical field has brought to light the highly

dangerous character of the radiographer's work. Severe dermatitis and cancer may ensue after exposure to X rays.

The following protective devices prove effective in preventing the injurious action of extreme light:

(1) Shields.
(2) Helmets.
(3) Goggles which eliminate the ultra-violet and infra-red rays.
(4) Clothing which covers the skin completely.
(5) X-ray apparatus should be inclosed as completely as possible with lead plates.

E. Extreme light.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
Extreme light.....	Cataracts, retinitis, conjunctivitis, dermatitis, ulceration and exfoliation of the skin, electrical ophthalmia, cancer.	Blacksmiths; electricians; electric linemen; furnace workers; glass blowers; glass-furnace workers' incandescent-mantle hardeners; moving-picture machine operators; oxyacetylene cutters; photographers; puddlers (iron and steel); stokers; welders; X-ray workers.

F. INFECTIONS.

There are many infectious diseases, such as tetanus, trachoma, and syphilis, which are often of occupational origin. They are not, however, specifically occupational; that is, they do not arise from a condition caused by an industrial process. The conditions which cause these diseases in industry are identical with those which cause them out of industry. The above-mentioned diseases have not therefore been included in this list of occupational infections. Those diseases which have been included arise primarily in occupational exposure. There are a number of other diseases which occur in occupations, but these are of such little numerical importance that they also have not been included.

Besides the general rules of sanitation, the following measures are recommended:

(1) *Anthrax.*—All hides and animal hair must be thoroughly sterilized. Foreign skins or hair should not be carried on the unprotected shoulder. The hands should be frequently washed with bichloride of mercury. Hair sorters should wear respirators.

(2) *Hookworm.*—Workers in mines and others who are exposed to infected soil should make special effort to keep the skin clean. Shoes must always be worn and gloves are also of value in preventing the entrance of the hookworm through the skin. Infected soil should be disinfected and kept dry. The stools of infected individuals must be disinfected immediately.

(3) *Septic infections.*—Workers should avoid puncturing the skin. Cuts, scratches, or abrasions should be treated at once to avoid in-

fection. Men having open wounds should not be allowed to work with putrid material.

F. Infections.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
1. Anthrax: External.....	1. *Malignant pustule.*—Begins as an aimed pimple or boil. Papule becomes hard, with a purple center and deep red zone of infiltration surrounding, appearance of minute vesicular areola. Central papule becomes vesicular, discharges thick, bloody serum, later forming a brown gangrene. A painful lymphangitis with hard edema extending over neck and arm. Local phlebitis in the edematous area, chilliness, anorexia, vomiting, prostration, high temperature, feeble pulse. 2. *Malignant edema.*—A spreading inflammation of loose connective tissue accompanied by sloughing and gangrene. Constitutional symptoms those of pyemia.	Animal handlers; hiders (tannery); beam house workers (tannery); brush makers; butchers; carpet makers; cattle salesmen; cobblers; curriers; farmers; fertilizer makers; fur carders; fur clippers; fur cutters; fur handlers; fur preparers; fur pullers; hair workers; leather workers; lime pullers (tannery); longshoremen; meat inspectors; preparers (tannery); shavers (felt hats, fur tannery); shaving brush makers; shepherds; stablemen; sumackers (tannery); table hands (tannery); tannery workers; taxidermists; transporters of hides and wool; veterinarians; wool carders; wool spinners; wool workers.
Internal.....	High fever, pains in head and back, vomiting, constipation, pain and tenderness in the abdomen, rapid, feeble pulse, palpable spleen, dyspnea, cyanosis. May be hemorrhage from bowels. When lungs are involved, there are additional symptoms—cough, pain in the chest, suffocation.	
2. Hookworm (ankylostomiasis).	Anemia, pallor of the face even when the blood count is not very low; a dull, heavy, listless expression, manner, speech, and gait; increasing muscular weakness; occurrence of parasites in stool. Victims often complain of gastrointestinal pains and cramps; in exaggerated cases there are edema, ascites, progressive emaciation, protuberant abdomen, and increasing stupor.	Brick makers; construction campworkers; farmers; lumbermen; miners; quarrymen; sawmill workers; trench diggers; tunnel workers; workers who come in contact with infected soil, especially prevalent in gold mines of California.
3. Septic infections..	Skin infections such as boils, carbuncles, blood poisoning, localized lymphangitis or cellulitis.	Animal handlers; butchers; canners; feather workers; fertilizer makers; garbage workers; glue makers; hair workers; preparers (tannery); rag workers; shavers (felt hats, fur, tannery); shoddy makers; silk workers; soap makers; tallow refiners; tannery workers; veterinarians; handlers of putrid or decomposing animal products.

G. Poor Illumination.

The effects of poor illumination are not easily apparent. The hazard may be present in any plant, but is especially prevalent in a limited number of occupations because of the peculiar conditions that make it difficult properly to illuminate the workroom. Miner's nystagmus is the outstanding example of the effects of this hazard. Poor illumination is not only the cause of the conditions listed below but is also an important factor in the causation of accidents.

Artificial light is least harmful to the worker when it comes from overhead, reflected from the ceiling by inverted bowl-shaped reflectors. Light-colored walls and ceilings aid materially in properly illuminating a room. Special precaution must be taken to avoid glare. All lights should be shaded so that only diffused light reaches the eye.

G. Poor illumination.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
Poor illumination...	Nystagmus, eyestrain, deficient vision due to astigmatism or hyperopia, headache, giddiness. Eyestrain contributes to neurasthenia.	Buffers; burnishers (iron and steel); caisson workers; compositors; embroidery workers; jewelers; metal polishers; miners; photographers; steel engravers; tunnel workers; watchmakers; any factory worker.

H. Repeated Motion, Pressure, Shock, Etc.

Under this heading are included those muscle-strain conditions which are caused by the continuous repetition of movements, pressure, or blows. This section is not concerned with the neurasthenic phenomena which are sometimes called occupational neurosis. Everyone is familiar with the muscular strain experienced in performing for the first time some exercise, such as rowing, long walking, etc. Men newly introduced into a process requiring such repeated action are affected similarly but often much more severely, so as to disable them temporarily for the particular job. The injury does not stop with muscular strain but may even cause inflammation of the surrounding sheaths or paralysis of the parts concerned.

Many types of occupational neurosis may be avoided by working at a comfortable pace, avoiding fatigue. Where continuous pressure or shock is the cause, pads or cushions are often beneficial. Workers who have to grasp tools tightly would do well frequently to change their method of holding the instrument, if this is possible. Occasional rest periods will do much toward the prevention of muscular pains and cramps.

H. Repeated motion, pressure, shock, etc.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
Repeated motion, pressure, shock, etc.	Pain of muscle used, set up by a myositis, bursitis, synovitis, or other local changes of a chronic inflammatory nature; trembling, gradual emaciation and partial paralysis of parts, acroparesthesia.	Artificial-flower makers; barbers; bicyclists; blacksmiths; carpenters; chauffeurs; clerks; cobblers; compositors; cotton twisters; dancers; diamond cutters; elevator runners; enamelers; engravers; gold beaters; hammermen; jewelers; knitters; lathe turners; letter sorters; lithographers; locksmiths; machinists; masons; microscopists; millers; miners; musicians; painters; paper-box makers; pavers; pneumatic-tool workers; porters; pressers; riveters; sailors; sawyers; scissors sharpeners; seamstresses; sewing machine operators; spinners (textiles); stone cutters (dry); stone cutters (wet process); tailors; telegraphers; typists; washerwomen; watchmakers; weavers.

J. Poisons.

The continued introduction of new processes making use of new poisonous substances in industry makes this section of more and more importance. The enormous increase in the production of dyestuffs and other chemicals will no doubt show its effects on the workmen in the form of industrial poisoning. During the war the increased production of trinitrotoluol and tetrachlorethane for airplane dope resulted in a large number of cases of poisoning from these substances. For the data presented under this heading, the revised "List of industrial poisons," compiled by Sommerfeld and Fischer for the International Association for Labor Legislation, has been drawn upon largely. The arrangement is similar.[3] The material in that list has been revised and brought up to date. Several poisons have been added and all the occupations exposed are given for each poison. The symptons are those given by recent investigators. In order to avoid swelling the list of poisons to unwarranted proportions, substances the effects of which are similar have been grouped. Thus all nitro compounds of benzol and its homologues have been included under one heading and the same procedure has been followed with amido compounds. An endeavor has been made to limit this list to those substances the actions of which are mainly constitutional. The next section (p. 912) is devoted to the substances occurring in industry which act as skin irritants. Because of the very large number of substances in the latter class, it has not been possible to treat them as fully as the other poisons.

To prevent industrial poisoning the following precautions should be taken: Personal cleanliness must be maintained. Workers must be instructed as to the toxicity of the substances handled. Frequent medical examinations of workers must be made to detect early symptoms of disease. Men should not be allowed to eat in workrooms where poisonous substances are handled. Work clothes should be removed at end of day's work. Proper lavatory facilities should be provided. Work clothes should receive special attention. The use of gloves and boots are often necessary. Mechanical devices for confining the poisons are of prime importance. (See also preventive measures, under "Dust.") Fumes and gases should be taken care of by proper ventilation, the use of exhaust systems, fans, and blowers. Men who work in an atmosphere polluted by poisonous fumes and gases should always wear gas masks properly suited for the obtaining conditions.

[3] See United States Bureau of Labor, Bulletin No. 100, May, 1912.

J. Poisons.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
1. Acetaldehyde	Irritation of the mucous membranes of the nose, larynx, bronchi, and eyes; acceleration of the heart's action; profuse night sweats.	Aldehyde pump men; celluloid makers; dye makers; explosives workers; mirror silverers, varnish makers; vinegar workers.
2. Acridine.....	Irritation and inflammation of skin and mucous membranes, severe burning and itching of the skin, violent sneezing.	Dye makers.
3. Acrolein.....	Itching in the throat, irritation of the eyes, exciting lachrymation, conjunctivitis, irritation of the air passages, bronchial catarrh.	Bone renderers; fat renderers; galvanizers; lard makers; linoleum makers; linseed oil boilers; soap makers; stearic-acid makers; tallow refiners; tinners; varnish boilers.
4. Ammonia.....	Acute inflammation of the respiratory organs, cough, edema of the lungs, chronic bronchial catarrh, redness of the eyes, increased secretion of saliva, retention of the urine.	Acetylene makers; ammonium-salts makers; artificial-ice makers; artificial-silk makers; boneblack makers; bronzers; coke-oven workers; dye makers; dyers; galvanizers; gas illuminating workers; gas purifiers; glue makers; mercerizers; refrigerating-plant workers; salt extracters (coke-oven by-products); sewer workers; shellac makers; shoe finishers; soda makers; sugar refiners; tinners; varnish makers.
5. Amyl acetate.....	Nervous symptoms, headache, illness of the head, giddiness, numbness, nausea, disturbances of digestion, palpitation of the heart, inflammation of the respiratory organs, fatty degeneration of the liver	Alcohol-distillery workers; art-glass workers; artificial-silk makers; battery (dry) makers; bronzers; buffers (rubber); celluloid makers; cutlery makers; enamelers; explosives workers; furniture polishers; gilders; incandescent-lamp makers; jewelers; lacquer makers; linoleum makers; mottlers (leather); patent-leather makers; polishers; shellac makers; shoe factory workers; shoe finishers; smokeless-powder makers; toy makers; wirers (incandescent lamps).
6. Amyl alcohol.....	Congestion of the head, oppression of the chest, irritation of the air passages, lowering of the blood pressure, faintness, nausea.	Alcohol-distillery workers; dye makers; fruit-essence makers; mordanters; shoe finishers.
7. Aniline and other amino compounds of benzol and its homologues.	Pallor of the skin, vertigo, unsteady gait, loss of appetite, increased frequency of respiration, anemia, slowing of the pulse, eczematous eruptions, bloody urine, spasmodic muscular pains, cyanosis.	Aniline makers; artificial-leather makers; calico printers; coal-tar workers; compositors; compounders (rubber); dye makers; explosive workers; feather workers; lithographers; military workers; mixers (rubber); painters; paint makers; pencil (colored) makers; photographic workers; pressroom workers (rubber); printers; reclaimers (rubber); rubber workers; tannery workers; vulcanizers.
8. Antimony and its compounds.	Itching eruptions of the skin, inflammation of the mouth, throat, and stomach; albumin in the urine, weakness of the heart, vertigo, faintness, coryza, dyspepsia, intestinal colic, nephritis.	Antimony extractors (refiners); brass founders; burnishers (iron and steel); burnishers (rifle barrels); calico printers; color makers; compositors; compounders (rubber); dye makers; enamel makers; filers; fireworks makers; glass mixers; glaze dippers (pottery); glaze mixers (pottery); grinders (metals); grinders (rubber); lead smelters; linotypers; mixers (rubber); monotypers; mordanters; pressroom workers (rubber); printers; rubber workers; shot makers; stereotypers; vulcanizers.
9. Arsenic and its compounds.	Headache, melancholia, sleeplessness, gastric disturbances, emaciation, catarrh of the mucous membranes, skin diseases of various forms, falling out of the hair and nails, melanosis, perforations of the nasal	Arsenic roasters; artificial-flower makers; artificial leather makers; bookbinders; brass founders; bronzers; calico printers; candle (colored) makers; carpet makers; carroters (felt hats); chargers (zinc smelters); color makers; colored-paper workers; compounders (rubber); copper founders; copper smelters; curriers (tannery); cut-glass workers; decorators (pottery); dye makers; electroplaters; enamelers; feather curers; feather workers; felt-hat makers; ferrosilicon workers; fur dyers; fur preparers; galvanizers; gardeners; glass mixers; glaze dippers (pottery); glaze mixers (pottery); gold refiners;

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
9. Arsenic and its compounds—Continued.	septum; bleeding gums, peripheral multiple neuritis, paralysis.	insecticide makers; japan makers; jewelers; lead smelters; linoleum colorers; lithographers; mixers (rubber); mordanters; paper glazers; paperhangers' pencil (colored) makers; pitch workers; pottery workers; pressroom workers (rubber); printers; pyrites burners; refiners (metals); rubber-tire builders; rubber washers; rubber workers; sealing-wax makers; sheep-dip makers; shot makers; sprayers (trees); sulphur burners; sulphuric-acid workers; tannery workers; taxidermists; tinners; toy makers; velvet makers; wallpaper printers; wax-ornament makers; wire drawers; wood preservers; zinc miners.
10. Arseniureted hydrogen.	General malaise, difficulty of breathing, fainting fits, gastric disturbance, jaundice, bluish discoloration of the mucous membrane, pain in the region of the spleen and kidney, darkened urine, fetor of the mouth resembling garlic.	Acid dippers; aniline workers; balloon (toy) fillers'; battery (dry) makers; bronzers; carbonizers (shoddy); dimethyl-sulphate makers; dye makers; enamelers; ferrosilicon workers; fertilizer makers; galvanizers; lead burners; silicon workers; fertilizer makers; galvanizers; lead burners; lime burners; nitroglycerin makers; picklers; refiners (metals); shoddy workers; submarine storage battery workers; sulphuric acid workers; tinners; towermen (sulphuric acid); zinc chloride makers.
11. Benzine	Headache, vertigo, nausea, cough, irregular respiration, weakness of the heart, drowsiness, cyanosis, twitching of the muscles, psychosis, skin lesions.	Art-glass workers; bronzers; buffers (rubber); cast scrubbers (electroplaters); celluloid makers; cementers (rubber shoes); cement mixers (rubber); compositors; compounders (rubber); curriers (tannery); decorators (pottery); degreasers (fertilizer, leather); dippers (rubber); dry cleaners; electroplaters; enamelers; feather workers; furniture polishers; gilders; glue workers; japan makers; lacquer makers; linoleum makers; lithographers; millinery workers; mixers (rubber); mordanters; painters; paint makers; pressroom workers (rubber); printers; putty makers; rubber-glove makers; rubber-tire builders; rubber washers; rubber workers; shellac makers; shoe finishers; tannery workers; type cleaners; varnish makers; vulcanizers.
12. Benzol	Headache, vertigo, anemia, muscular tremor, scarlet lips, spots of extravasated blood in the skin, irritant cough, fatty degeneration of liver, kidneys, and heart.	Aniline makers; artificial-leather makers; battery (dry) makers; benzol stillmen; bronzers; carbolic-acid makers; cast scrubbers; cementers (rubber shoes); cement mixers (rubber); coal-tar workers; coke-oven workers; color makers; compounders (rubber); decorators (pottery); degreasers (fertilizer, leather); dry cleaners; driers (rubber); dye makers; electroplaters; explosives workers; feather workers; fertilizer makers; gas (illuminating) workers; gilders; glue workers; lacquer makers; lithographers; millinery workers; mixers (rubber); mordanters; painters; paint makers; photo-engravers; photographic workers; pressroom workers (rubber); reclaimers (rubber); rubber-tire builders; rubber washers; rubber workers; shellac makers; shoe-factory workers; shoe finishers; smokeless-powder makers; still (coal-tar) cleaners; treaders (rubber); varnish makers; vulcanizers.
13. Brass (zinc)	Headache, general malaise, throat irritation, cough, nausea, vomiting, constipation, trembling, muscular pains, accelerated respiration, profuse sweating, deposit of green tartar on the teeth, metallic taste in the mouth, anemia, premature old age, respiratory and degenerative diseases.	Bench molders (foundry); blowers-out (zinc smelting); brass founders; braizers; bronzers; chargers (zinc smelting); core makers; floor molders (foundry); galvanizers; junk-metal refiners; luters (zinc smelting); pourers (brass foundry); welders; zinc smelters.
14. Carbon dioxide	Anemia, cyanosis, headache, drowsiness, vertigo, tinnitus, and general nervousness.	Alkali-salt makers; blacksmiths; boiler-room workers; brass founders; brewers; brick burners; caisson workers; carbon-dioxide makers; charcoal burners; drying-room workers (miscellaneous); fertilizer makers; furnace workers; lime burners; limekiln chargers; miners; pottery workers; sewer workers; silo workers; soda makers; starch makers; sugar refiners; vinters; white-lead makers; yeast makers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
15. Carbon disulphide.	Headache, pain in the extremities, trembling, deafness, reduction of the reflexes, acceleration of the heart's action, nausea, digestive trouble, emaciation, disturbance of sense of vision, excitement and violent temper followed by depression, hyperstimulation of sexual instinct, later its abnormal decline, chronic dementia.	Ammonium-salts makers; artificial-silk makers; asphalt testers; carbon-disulphide makers; celluloid makers cementers (rubber shoes); cement mixers (rubber); dry cleaners; driers (rubber); enamelers; glue workers; insecticide makers; match-factory workers; oil extractors; paint makers; paraffin workers; putty makers; reclaimers (rubber); smokeless-powder makers; sulphur extractors; tallow refiners; vulcanizers.
16. Carbon monoxide.	Headache (usually frontal), dizziness, sense of fullness of the head, fatigue, nausea, general weakness, polycythemia.	Acetylene makers; bakers; bisque-kiln workers; blacksmiths; blockers (felt hats); boiler-room workers; brass founders; cable splicers; calico printers; carbide makers; celluloid makers; charcoal burners; chargers (zinc smelting); chimney sweepers; coal-tar workers; coke-oven workers; copper smelters; core makers; drying-room workers (miscellaneous); enamelers; felt-hat makers; filament makers (incandescent lamps); finishers (incandescent lamps); flangers (felt hats); flue cleaners; foundry workers; furnace workers; garage workers; gas (illuminating) workers; glost-kiln workers; incandescent-lamp makers; kiln tenders; laundry workers; lead smelters; lime burners; limekiln chargers; mercury smelters; miners; patent-leather makers; phosgene makers; pottery workers; pressers; refiners (metals); sealers (incandescent lamps); silver melters; singers (cloth); soda makers; stokers; teazers (glass); temperers; tubulators (incandescent lamps); zinc smelters.
17. Chloride of lime.	Irritating cough, inflammation of upper air passages, difficulty of breathing, bronchitis, asthma, sometimes hemoptysis, conjunctivitis, lachrymation, hyperhidrosis, burning eruption on the skin.	Bleachers; chloride of lime makers; chloroform makers; disinfectant makers; dye makers; laundry workers; tannery workers.
18. Chlorine.....	Pallid countenance, emaciation, decayed teeth, bronchial irritation and asthma, gastric disturbances, irritation of the skin, chloracne.	Alkali-salt makers; beatermen (paper and pulp); bleachers; broom makers; calico printers; chloride of lime makers; chlorine makers; disinfectant makers; dye makers; laundry workers; phosgene makers; photographic workers; sulphur-chloride makers; zinc-chloride makers.
19. Chlorodinitrobenzol.	*See* Nitrobenzol.....	
20. Chloronitrobenzol.	*See* Nitrobenzol.....	
21. Chromium compounds.	Pitlike, phagedenic ulcers, very difficult to heal and very painful; perforation of the nasal septum at the cartilaginous portion, irritation of the conjunctiva, small areas of inflammation in the lungs, inflammation of the kidneys, chronic gastritis, anemia.	Artificial-flower makers; battery (dry) makers; bleachers; calico printers; candle (colored) makers; chromium workers; color makers; compounders (rubber); dye makers; dyers; enamelers; glass mixers; glaze dippers (pottery); glaze mixers (pottery); ink makers; linoleum colorers; lithographers; match-factory workers; mixers (rubber); mordanters; paperhangers; pencil (colored) makers; photo-engravers; photographic workers, pressroom workers (rubber); rubber-tire builders; rubber washers; rubber workers; tannery workers; vulcanizers; wall-paper printers; wax-ornament workers; wood stainers.
22. Cyanogen compounds.	Headache, vertigo, unsteadiness of gait, nausea, loss of appetite, disturbance of gastric and intestinal functions, slowing of the pulse, albuminuria.	Acid dippers; ammonium-salts makers; blacksmiths; blast-furnace workers; browners (gun barrels); calico printers; case hardeners; celluloid makers; dye makers; electroplaters; fulminate mixers; fumigators; gas (illuminating) workers; gas purifiers; gold refiners; photographic workers; picklers; silver refiners; tannery workers, temperers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
23. Dimethyl sulphate.	Strongly corrosive effect on the skin and mucous membranes, hoarseness, lachrymation, conjunctivitis, edema, photophobia.	Dimethyl-sulphate makers; dye makers; perfume makers.
24. Dinitrobenzol...	*See* Nitrobenzol.....	
25. Gasoline.....	*See* Naphtha.....	
26. Hydrochloric acid.	Irritation of mucous membranes; conjunctivitis; coryza; pharyngeal, laryngeal, and bronchial catarrh; dental caries.	Acid dippers; acid finishers (glass); acid mixers; acid recoverers; acid transporters; alkali-salt makers; ammonium salts makers; aniline makers, battery (dry) makers; calico printers; camphor makers; carbolic-acid makers; carbonizers (shoddy); cartridge dippers; dye makers; dyers; enamel makers; fertilizer makers; galvanizers; glass finishers; glass mixers; glue workers, hydrochloric-acid makers; jewelers; petroleum refiners; picklers; pottery workers; reclaimers (rubber); rubber workers; shoddy workers; solderers; sulphur-chloride makers; tinners; vignetters; zinc-chloride makers.
27. Hydrofluoric acid.	Intense irritation of the eyelids and conjunctiva, coryza, bronchial catarrh with spasmodic cough; ulceration of the nostrils, gums, and oral mucous membrane; painful ulcers of the cuticle, erosion and formation of vesicles, suppuration under the finger nails.	Antimony fluoride extractors; art-glass workers; bleachers; dyers; etchers; fertilizer makers; glass finishers; silicate extractors.
28. Lead and its compounds.	Sallow, pale, yellowish hue of the skin; metallic taste, nausea, anorexia, constipation, lead line, asthenia, lassitude, headaches, arthralgias and neuritis, weakness of grip, tremors of fingers and tongue; lead paralyses, especially of muscles used most; atrophy of optic nerve.	Acid finishers (glass); amber workers; art-glass workers; artificial-flower makers; babbitters; battery (dry) makers; bench molders (foundry); blacksmiths; bleachers (tannery); bookbinders; bottle-cap makers; brass founders; brass polishers; braziers; brick burners; brick makers; bronzers; browners (gun barrels); brush makers; buffers (rubber); burners (enameling); cable makers; cable splicers; calico printers; canners; cartridge makers; celluloid makers; chargers (zinc smelting); color makers; colorers (white) of shoes; compositors; concentrating-mill workers (lead and zinc); cut-glass workers; cutlery makers; decorators (pottery); diamond polishers; dye makers; dyers; electroplaters; electrotypers; emulsionery workers; emery-wheel makers; enamel makers; file cutters; filers; floor molders (foundry); galvanizers; glass finishers; glass mixers; glass polishers; glaze dippers (pottery); glaze mixers (pottery); glost-fire workers; gold refiners; grinders (metals); grinders (rubber); heater boys (riveters); imitation-pearl makers; incandescent-lamp makers; insecticide makers japan makers; jewelers; junk-metal refiners; lathers (paint cans); lacquer makers; lead burners; lead-foil makers; lead miners; lead-pipe makers; lead-salts makers; lead smelters; linoleum makers; linotypers; linseed-oil boilers; lithographers; lithotransfer workers; matchfactory workers; mirror silverers; mixers (rubber); monotypers; musical-instrument makers; nitric-acid workers; nitroglycerin makers; painters; paint makers; paint removers; paperhangers; patent-leather makers; petroleum refiners; photographic retouchers; pipe fitters; plumbers; polishers; pottery workers; printers; putty makers; putty polishers (glass); reclaimers (rubber); red-lead workers; refiners (metals); riveters; roofers; rubber workers; sagger makers; sandpaperers (enameling and painting auto bodies, etc.); screen workers (lead and zinc smelting); sheet-metal workers; shellac makers; shot makers; slip makers (pottery); slushers (porcelain enameling); solderers; stainers (shoes); steel engravers; stereotypers, storage-battery makers; sulphuric-acid workers; table turners (enameling); tannery workers; temperers; tile makers; tin-foil makers; tinners; toy makers; transfer workers (pottery); tree sprayers; type founders; typesetters; wallpaper printers; welders; white-lead workers; wood stainers; zinc smelters.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
29. Mercury and its compounds.	Ptyalism: swelling, inflammation, and bleeding of the gums; blue line on the gums, rodent ulcers, pallor, mercurial tremor, digestive disturbances, localized white spots in the mucosa surrounded by pale blue or reddened area, general weakness of the hand and digital extensors, foul breath, corrosion of the teeth, furunculosis, sleeplessness and depression or drowsiness and apathy, loss of energy and initiative.	Artificial-flower makers; battery (dry) makers; blowers (felt hats); bronzers; browners (gun barrels); brushers (felt hats); cap loaders; carroters (felt hats); cartridge makers; chlorine makers (electrolytic); color makers; coners (felt hats); dentists; detonator cleaners; detonator-fillers; detonator packers; devil operators (felt hats); dye makers; Edison storage battery workers; explosive workers; felt-hat makers; fireworks makers; fulminate mixers; fur handlers; fur preparers; gold refiners; hardeners (felt hats); incandescent-lamp makers; jewelers; mercurial-vapor-lamp makers; mercury bronzers; mercury miners; mercury-salts workers; mercury smelters; mercury-solder makers; mercury-still cleaners; mirror silverers; mixers (felt hats); paint makers; photographic workers; primers (explosives); refiners (metals); sizers (felt hats); sole-stitchers (Blake machine); starters (felt hats); steel engravers; stiffeners (felt hats); storage-battery makers; taxidermists; thermometer makers; water gilders; zinc-electrode makers.
30. Methyl alcohol..	Headache, nausea, abdominal cramps, ringing in the ears, muscular prostration, insomnia, delirium, difficulty of breathing, inflammation of the throat and mucous membrane of the air passages, conjunctivitis, serious affections of the retina and optic nerve resulting in blindness, fatty degeneration of the liver.	Aldehyde pumpmen; art-glass workers; artificial-flower makers; artificial silk makers; boot-finders; bronzers; brush makers; calico printers; celluloid makers; cementers (rubber shoes); dimethy sulphate makers; dry cleaners; dryers (felt hats); dye makers; explosives workers, leather workers; felt-hat makers; filament makers (incandescent lamps); fitters (shoes); furniture polishers; gilders; hardeners (felt hats); incandescent lamp makers; ink makers; japan makers; lacquer makers; lasters (shoes); linoleum makers; millinery workers; mottlers (leather); painters; paint makers; patent leather makers; perfume makers; photo engravers; photographers; polishers; shellac makers; shoe-factory operatives; shoe finishers; soap makers; stiffeners (felt hats); stitchers (shoes); tyre cleaners; upholsterers; varnish makers; vulcanizers; wood-alcohol distillers; woodworkers.
31. Methyl bromide.	Vertigo, headache, staring look, pallor of the skin, retarded pulse, constipation, excitability, trembling.	Antipyrin makers; dye makers.
32. Naphtha.....	Headache, vertigo, nausea, vomiting, dyspnea, palpitation, insomnia, hysteria.	Bronzers; chauffeurs; degreasers (fertilizer, leather); dyers; furniture polishers; garage workers; gilders; metal-polish makers; painters; petroleum refiners; polishers; rubber workers; shoe finishers; waterproof-cloth makers; woodworkers.
33. Nitraniline.....	*See* Aniline.	
34. Nitrobenzol and other nitro compounds of benzol and its homologues.	Icterical skin which gradually becomes cyanotic, methemoglobin formation, general debility, anemia, presence of hematoporphyrin, albumin, and sometimes free poison in the urine; skin eruptions, visual disturbances, dyspnea, odor of bitter almonds in breath.	Aniline makers; dye makers; explosives workers; perfume makers; smokeless-powder makers; soap makers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
35. Nitroglycerin....	Severe headache, vertigo, nausea, paralysis of the muscles of the head and eyes as well as of the lower extremities, cyanosis, reddening of the countenance, burning in the throat and stomach, disturbances of digestion, trembling, neuralgia, colic, retarded respiration and heart action, obstinate ulcers under nails and on the finger tips, eruptions on the plantar aspect of the feet and interdigital spaces, with extreme dryness and formation of fissures.	Explosives workers; nitroglycerin workers; shell fillers.
36. Nitronaphthalene.	*See* Nitrobenzol.	
37. Nitrous gases and nitric acid.	Irritation of air passages, cough, labored respiration, inflammation of the eyes, corrosion of the teeth, erosion and perforation of nasal septum.	Acid dippers; acid mixers; acid recoverers; acid transporters; aniline makers; artificial leather makers; bleachers; carroters (felt hats); cartridge dippers; celluloid makers; dimethyl sulphate makers; dippers (guncotton); enamelers; etchers; explosive workers; felt-hat makers; fertilizer makers; fur preparers; galvanizers; glue workers; guncotton dippers; guncotton wringers; imitation-pearl makers; incandescent lamp makers; jewelers; lithographers; miners; mordanters; nitrators; nitric-acid workers; nitroglycerin workers; photo-engravers; picklers; picric-acid makers; refiners (metals); soda makers; steel engravers; sulphuric-acid workers; towermen (sulphuric acid); wringers (guncotton).
38. Petroleum.....	Inflammation of the skin, acne, suppurating ulcers; papilloma; numbness and irritation of the Schneiderian membrane; headache and sensory disturbances; affections of the respiratory organs.	Browners (gun barrels); feather workers; furniture polishers; lampblack makers; millinery workers; oil-flotation-plant workers; oil-well workers; paraffin workers; petroleum refiners; temperers.
39. Phenol.....	Erosion of the skin, eczema, irritation of respiratory organs, digestive disturbances, symptoms of degeneration of the blood, emaciation, nephritis, gangrene, icterus.	Bakelite makers; calico printers; coal-tar workers; dye makers; dyers; etchers; gas (illuminating) workers; gas purifiers; lampblack makers; picric acid makers; rubber workers; smokeless powder makers; stillmen (carbolic acid); surgical-dressing makers; wood preservers.
40. Phenyl hydrazine.	Vesicular eruptions on the skin with itching and burning, diarrhea, loss of appetite, granular degeneration of the blood corpuscles, formation of methemoglobin, a sense of general malaise.	Antipyrin makers; dye makers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
41. Phosgene.....	Destruction of lung tissue, emphysema and edema, myocardial insufficiency due to the emphysema, pleural thickening and adhesions, chronic bronchitis, mild diffuse bronchiectasis, nocturnal dyspnea, polycythemia.	Dye makers; phosgene makers.
42. Phosphorus.....	Inflammation and sclerosis of the bones and of the periosteum, necrosis of the bones of the jaw, swelling and ulceration of the gums and buccal membrane, loosening and falling out of the teeth, suppuration and destruction of jawbone with fistulous channels burrowing through the cheek, meningeal inflammation, brittleness of bones, digestive disturbances, emaciation.	Boneblack makers; brass founders; fertilizer makers; fireworks makers; insecticide makers; match-factory workers; phosphate-mill workers; phosphor-bronze workers; phosphorus-compounds makers; phosphorus extractors.
43. Phosphuretted hydrogen.	Oppressed feeling in the chest, headache, vertigo, tinnitus aurium, general debility, loss of appetite, great thirst.	Acetylene makers; ferrosilicon workers; phosphorus extractors; phosphorus (red) makers.
44. Picric acid.....	Itching, inflammation of the skin, vesicular eruptions, yellow pigmentation of epidermis and conjunctiva, inflammation of buccal mucous membrane, digestive disturbances, vertigo, jaundice, nasal catarrh, nephritis.	Dye makers; dyers; explosives workers; photographers; picric acid makers; shell fillers; smokeless-powder makers.
45. Sulphur chloride.	Symptoms are due to the combined effects of chlorine, hydrochloric acid and sulphur dioxide. Sulphur chloride when in contact with moisture reacts with water to form these products.	Rubber-substitute makers; vulcanizers.
46. Sulphur dioxide.	Irritation of the mucous membrane of respiratory organs and eyes, spasmodic cough, bronchial catarrh, digestive disturbances, blood-tinged mucous.	Alkali-salt makers; blast-furnace workers; bleachers; brass founders; brick makers; broom makers; carbolic acid makers; chambermen (sulphuric acid); chargers (zinc smelting); copper smelters; dye makers; fertilizer makers; flue cleaners; fruit preservers; fumigators; galvanizers; glue workers; lead smelters; mercury smelters; oil-flotation-plant workers; petroleum refiners; pottery workers; pyrites burners; refiners (metals); rubber workers; storage battery makers; sugar refiners; sulphite cooks; sulphur burners; sulphurers (hops and malt); sulphuric-acid workers; tannery workers; towermen (sulphuric acid); zinc smelters.
47. Sulphuretted hydrogen.	Headache, debility, vertigo, nausea, disturbances of digestion, sallow complexion and emaciation, slowing of the pulse, conjunctival catarrh, tendency to the formation of boils.	Alkali-salt makers; artificial-silk makers; blast-furnace workers; bronzers; cable splicers; celluloid makers; dye makers; fertilizer makers; flax-rettery workers; gas (illuminating) workers; gas purifiers; glue workers; match-factory workers; miners; oil-flotation-plant workers; petroleum refiners; pyrites burners; sewer workers; soda makers; sodium sulphide makers; starch makers; sugar refiners; tannery workers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
48. Sulphuric acid..	Inflammation of respiratory organs, injury to teeth through softening of the dentine, chronic catarrh.	Acid dippers; acid finishers (glass); acid mixers; acid recoverers; acid transporters; ammonium-salts makers; ammonium-sulphate makers; artificial-leather makers; beta-still operators (beta naphthol); burnishers (iron and steel); calico printers; carbolic acid makers; carbonizers (shoddy); cartridge dippers; celluloid makers; chambermen (sulphuric acid); dimethyl-sulphate makers; dye makers; explosives workers; felt-hat makers; fertilizer makers; galvanizers; glass finishers; guncotton dippers; hydrochloric acid makers; jewelers; linoleum makers; mercerizers; nitrators; nitric-acid makers; nitroglycerine makers; oil-flotation-plant workers; patent-leather makers; petroleum refiners; phosphorus-evaporating machine operators; picklers; picric acid makers; reclaimers (rubber); salt extractors (coke oven byproducts); shoddy workers; storage-battery makers; sulphuric-acid workers; tallow refiners; tannery workers; temperers; towermen (sulphuric acid); wire drawers.
49. Tar.....	Tar itch, diffuse acne, eczema or psoriasis, loss of appetite, nausea, diarrhea, headache, numbness, vertigo, albuminuria, edema, ischuria, conjunctivitis, bronchitis.	Battery (dry) makers; briquet makers; brush makers; chimney sweepers; coke-oven workers; cord makers; flue cleaners; gas (illuminating) workers; insulators; paint makers; paraffin workers; pavers; petroleum refiners; roofers; roofing-paper workers; still (coal-tar) cleaners; tar workers; wood preservers.
50. Tetrachlorethane (acetylene tetrachloride).	Abnormal sense of fatigue, profuse perspiration, general discontent and grouchiness, inability to concentrate, nocturia, slight polyuria, dreaming, headache, vertigo, nervousness, insomnia, loss of appetite, constipation, diarrhea, gas in stomach, general abdominal pain, nausea, eructations of gas, vomiting, loss of weight, jaundice, enlarged liver, bile in the urine, abdominal tenderness, increase of mononuclear cells, appearance of many immature large mononuclears, elevation in the white count, slight anemia, slight increase in number of platelets.	Airplane-wing varnishers; artificial-silk makers; tapers (airplanes).
51. Trinitrotoluol...	Nose and throat irritation, obstinate cough, bluish color of the lips and lobes of the ears, yellowing of the whites of the eyes, expectoration of yellow mucous, discoloration—a mixture of lividity and jaundice, rash on the skin, shortness of breath, anemia, palpitation of the heart, bile-stained urine, rapid weak pulse.	Explosive workers; shell fillers.

J. Poisons—Continued.

Health hazard.	Symptom, condition, or disease to look for.	Occupations which offer such exposure.
52. Turpentine.....	Irritation of the mucous membrane of the eyes, nose, and upper air passages; cough, bronchial inflammation; salivation; giddiness, headache, irritation of the kidneys, odor of violets in urine, severe irritation of the skin, eczema, and hardening of the epidermis.	Art-glass workers; cable splicers; calico printers; camphor makers; cementers (rubber shoes); decorators (pottery); dry cleaners; dye makers; enamelers; enamel makers; feather workers; furniture polishers; japan makers; lacquer makers; linoleum makers; lithographers; millinery workers; painters; paint makers; patent-leather makers; printers; rubber workers; sealing-wax makers; shellac makers; transfer workers (pottery); turpentine extractors; varnish makers.

SKIN IRRITANTS.

Because of the fact that dermatoses form such a large proportion of all occupational diseases and are often disabling, the more important occupations that are exposed to skin irritants have been listed separately. A complete enumeration of such occupations would be impossible. Almost any foreign substance can become a skin irritant if it is in continuous contact with the skin. Thus soap and water, which ordinarily do not irritate the skin, may cause severe dermatoses in washerwomen.

The data presented below are a compilation of the literature on the subject, taken largely from Dr. R. Prosser White's compilation of "Occupational Affections of the Skin."

Skin affections caused by different external irritants often show the same clinical picture. A number of occupational skin eruptions have no specific lesions or special pathology, which makes their differential diagnosis very difficult. Most superficial industrial skin diseases show simply a difference in degree of catarrhal inflammation, depending on the intensity of the irritant. For these reasons the symptoms for each irritating substance have not been listed as has been done for the other hazards.

Occupational dermatoses are characterized by their grouping, situation, mode of appearance, spread, and evolution. They crop up in series, retaining their initial type throughout, unless they are secondarily infected. They are most often local, except when they are a differentiating sign of the toxemias. The onset and development are usually sudden. The inflammation is sharply outlined. Exudation is excessive and there is deep-seated edema. The eruption usually predominates on the right side.

There are many cases of dermatitis which are caused by physical agents, such as heat, cold, friction, etc. In this bulletin these conditions are dealt with only as they are related to the hazards listed.

Thus among the symptoms for "Extreme dry heat" and "Extreme light" we find skin eruptions.

The following is the list of the more common occupations exposed to dermatoses with the irritating substances concerned:

Occupation exposed to specified skin irritants.

Occupation exposed.	Skin irritants.
Acetylene makers	Calcium carbide.
Acid workers	Acids.
Alkali-salt makers	Caustic alkali.
Artificial-flower makers	Caustic alkali, dyes.
Bakelite makers	Formaldehyde, phenol.
Barbers	Soap, hair tonics.
Battery (dry) makers	Acids, zinc chloride, ammonium salts, charcoal.
Beatermen (paper and pulp)	Caustic alkali, dyes.
Bleachers (cloth)	Acids, bleaching powder, caustic alkali, hydrogen peroxide, sodium silicate.
Blooders (tannery)	Dyes.
Bobbin carriers	Nitrobenzol, aluminum salts, formaldehyde, magnesium salts, sodium fluosilicate.
Bricklayers	Lime.
Bronzers	Dyes.
Broom makers	Dyes, vegetable dust.
Calico printers	Dyes.
Candy makers	Sugar.
Cap loaders	Mercury compounds.
Carbide makers	Calcium carbide.
Carbolic-acid makers	Caustic alkali, phenol.
Cardboard stickers	Sodium silicate.
Carroters (felt hats)	Acids, mercury compounds.
Cartridge dippers	Acids, soap.
Celluloid makers	Dyes.
Cementer (rubber shoes)	Benzine, coal-tar products, naphtha, methyl alcohol.
Cement workers	Lime.
Cloth preparers	Acids, caustic alkali, lime, soap, potassium salts, sodium salts, sodium silicate.
Confectioners	Sugar.
Cotton sizers	Acids, zinc, chloride, arsenic salts, phenol.
Curriers (tannery)	Paraffin, benzine.
Dampers (conditioning cotton)	Nitrobenzol, aluminum salts, formaldehyde, magnesium salts, sodium fluosilicate.
Dentists	Procain.
Detonator cleaners	Mercury compounds.
Detonator fillers	Mercury compounds.
Detonator packers	Mercury compounds.
Disinfectant makers	Formaldehyde.
Druggists	Bleaching powder, soap, iodoform, sodium salts, sugar.
Dye makers	Acids, benzine, caustic alkali, coal-tar products, dye intermediates, dyes, turpentine, antimony compounds, barium salts, calcium salts, cresol, dextrins, ferrocyanides, formaldehyde, gums, hydroquinone, lead salts, phenol, potassium chlorate.
Dyers	Dyes.
Electroplaters	Acids, benzine, caustic alkali, lime, potassium cyanide, soap, nickel sulphate.
Embalmers	Formaldehyde.
Engravers	Acids, caustic alkali, ferric chloride, potassium cyanide.
Etchers	Acids, caustic alkali.
Explosives workers	Dye intermediates, explosives (TNT, etc.), ammonium salts, bromine, mercury compounds.
Felt-hat makers	Acids, mercuric nitrate, dyes.
Fish dressers	Brine.
Flax spinners	Lime, brine.
Furniture polishers	Benzine, caustic alkali, naphtha, turpentine, methyla lcohol, pyridin, rosin.
Fur workers	Dyes.
Galvanizers	Ammonium chloride.
Gas-mantle impregnators	Thorium compounds.
Glass blowers	Charcoal, pitch, rosin.
Glass mixers	Caustic alkali.
Ink makers	Dyes.

Occupation exposed to specified skin irritants—Continued.

Occupation exposed.	Skin irritants.
Lampblack makers	Soot.
Laundry workers	Caustic alkali, soap.
Lime burners	Lime.
Lime pullers (tannery)	Lime.
Linoleum makers	Dyes.
Machinists	Cutting compounds, lubricants, oils.
Masons	Lime.
Match-factory workers	Dyes, dextrins, gums.
Mercerizers	Acids, caustic alkali.
Mixers (rubber)	Accelerators (hexamethylenetetramine).
Mordanters	Acids, caustic alkali, chromates, zinc chloride, aluminum salts, antimony compounds, arsenates, chromium salts, copper salts, iron salts, lead salts, phosphates, silicates, tin salts.
Mottlers (leather)	Dyes.
Nickel platers	Zinc chloride, nickel sulphate.
Nitroglycerin makers	Acids, explosives.
Packing-house employees	Brine.
Painters	Acids, caustic alkali, paints, zinc chloride.
Paint makers	Paints.
Paper-box makers	Glue.
Paraffin workers	Paraffin.
Parchment makers	Zinc chloride.
Pencil (colored) makers	Dyes.
Petroleum refiners	Caustic alkali, paraffin.
Photographers	Acids, caustic alkali, chromates, metol, pyrogallic acid, turpentine, amidol, bronzing powder, hydroquinone, rodinal.
Photographic plate cleaners	Caustic alkali.
Pitch workers	Pitch.
Plasterers	Lime.
Polishers	Caustic alkali, naphtha.
Polishers (silver and brass)	Potassium cyanide.
Printers	Ink, benzine.
Rock-salt workers	Brine.
Rope makers	Oil, tar.
Rubber workers	Accelerators (hexamethylenetetramine).
Salt preparers	Brine.
Scratch brushers (electroplating)	Acids, benzine, lime, oils.
Shell fillers	Explosives (TNT, etc.).
Shoe finishers	Benzine, coal-tar products, naphtha, methyl alcohol.
Sizers (cotton)	Zinc chloride, aluminum salts, calcium salts, magnesium salts.
Soap makers	Caustic alkali, soap, vegetable oils, sodium silicate.
Sodium hydroxide makers	Caustic alkali.
Solderers	Acids, zinc chloride.
Sugar refiners	Sugar.
Tannery workers	Acids, lime, sodium sulphide, arsenic salts, brine, calcium hydrosulphide, chromium salts.
Temperers	Oil, brine.
Tinners	Zinc chloride.
Tobacco rollers	Vegetable dust, vegetable oils.
Tube layers (cotton conditioning)	Nitrobenzol, aluminum salts, formaldehyde, magnesium salts, sodium fluosilicate.
Typists	Carbon paper.
Vulcanizers	Accelerators (hexamethylenetetramine).
Washers	Caustic alkali.
Washwomen	Caustic alkali, soap, sodium salts.
Watchmakers	Potassium cyanide.
Waterproofers (paper)	Paraffin.
Wax-ornament makers	Dye intermediates, potassium cyanide.
Wet-bobbin winders	Lime, aluminum salts, formaldehyde, magnesium salts, sodium fluosilicate.
Wood preservers	Tar, zinc chloride.
Zinc-chloride makers	Acids, zinc chloride.

Exhibit 7

HANDBOOK

OF THE

HOSPITAL CORPS

UNITED STATES NAVY

1939

PUBLISHED BY

THE BUREAU OF MEDICINE AND SURGERY

UNDER THE AUTHORITY OF

THE SECRETARY OF THE NAVY

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BUREAU OF MEDICINE AND SURGERY,
NAVY DEPARTMENT,
Washington, D. C., July 1, 1939.

The Handbook of the Hospital Corps, United States Navy, 1939, is a revised edition of the former Handbook of the Hospital Corps, United States Navy, 1930, and is compiled from articles prepared by members of the Medical, Dental, Hospital, and Nurse Corps, U. S. Navy, and reviewed and revised by Commander W. J. C. Agnew, Medical Corps, and Chief Pharmacist N. L. Saunders, U. S. Navy. It is published for the instruction and guidance of members of the Medical Department of the United States Navy and for use at the Hospital Corps Schools.

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Surgeon General, U. S. Navy.

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FOREWORD

In this 1939 edition of the Handbook of the Hospital Corps, U. S. Navy, the subject matter has been revised, enlarged, and brought up-to-date, as nearly as possible, with the sciences which are briefly discussed in the various chapters and sections.

The handbook is intended to serve as a general guide and reference book for the hospital corpsmen of the Navy, especially those performing duty independent of medical officers, and as a textbook for their instruction in the Hospital Corps Schools and elsewhere. It contains information and instructions concerning the duties of the Hospital Corps of the Navy, but hospital corpsmen, particularly those in the upper ratings, are urged to make frequent reference to the U. S. Navy Regulations, the Manual of the Medical Department, U. S. Navy, the manuals of other Navy Department bureaus, circular letters, etc., for additional information and instructions.

The principal subjects have been arranged in the order in which they occur in examinations for advancement in rating. As these subjects necessarily are presented in epitomized form, readers of the handbook should realize that the information contained in it must be supplemented by reference to the standard textbooks and professional journals usually available in the medical libraries of hospitals, ships, and stations.

The Bureau of Medicine and Surgery herewith expresses appreciation to the following-named members of the Medical Department, U. S. Navy for the time and effort spent in preparing, reviewing, and revising the material for this book:

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Commander G. B. McArthur, (MC), U. S. Navy	
Commander M. D. Willcutts, (MC), U. S. Navy	Minor Surgery and First Aid.
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Captain H. E. Harvey, (DC), U. S. Navy	Emergency Dental Treatment.
Captain W. L. Darnall, (DC), U. S. Navy	
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	Pharmacy.
Chief Pharmacist A. T. Schwartz, U. S. Navy	Toxicology.
Pharmacist P. S. Gault, U. S. Navy	
Chief Nurse J. Ferris, U. S. Navy	Nursing.
Chief Nurse P. W. Hoyle, U. S. Navy	Ward Management.
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Captain W. L. Mann, (MC), U. S. Navy	Field Sanitation.
Commander W. T. Brown, (MC), U. S. Navy	Duty with Marine Corps Expeditionary Forces.
Commander L. D. Arbuckle, (MC), U. S. Navy	Landing Force. Shore Patrol.
Nurse R. Dunbar, U. S. Navy	Diets and Messing for the Sick.
Lieut. Commander C. L. Bozarth, (MC), U. S. Navy; Pharmacist's mate second class, J. F. Reid, U. S. Navy	Chemistry.
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Chief Pharmacist N. L. Saunders, U. S. Navy	Administration and General Clerical Procedures.
Division of Finance, Bureau of Medicine and Surgery.	Hospital Supplies and Property Accountability.
Chief Pharmacist J. H. Bell, U. S. Navy	Commissary Supervision.
Captain C. W. O. Bunker, (MC), U. S. Navy; Chief Pharmacist R. Aikman, U. S. Navy	Deaths and Medico-Legal Matters.
Commander J. C. Adams, (MC), U. S. Navy	Aviation Medicine.
Commander J. M. McCants, (MC), U. S. Navy	Basal Metabolism.
Commander H. E. Ragle, (MC), U. S. Navy	Blood Grouping and Matching.
Commander B. H. Adams, (MC), U. S. Navy	Chemical Warfare.
Commander F. S. Johnson, (MC), U. S. Navy	Diving and Submarine Duty.
Captain C. R. Baker, (MC), U. S. Navy	Electrocadiography.
	Embalming. (Based on the Manual of the Medical Department, U. S. Navy.)
Chief Pharmacist C. P. Dean, U. S. Navy	Independent Duty.
Commander O. Wildman, (MC), U. S. Navy	Laboratory Procedures and Technique.
Lieutenant C. C. Welch, (MC), U. S. Navy	Physical Therapy.
Captain G. E. Thomas, (MC), U. S. Navy	Recruiting.
Commander W. A. Fort, (MC), U. S. Navy; Commander F. W. Muller, (MC), U. S. Navy	X-ray.

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It should always be remembered that diseases that have attacked more than half the men of the country during youth, diseases that bring misery to thousands of children and suffering to hundreds of thousands of women innocently infected, and that are incurred almost exclusively through promiscuous sexual intercourse, are diseases to be avoided. It should also be remembered that the man who practices promiscuous cohabitation almost invariably contracts one of the venereal diseases, sooner or later, in spite of every precaution. And if sufficient moral stamina to resist sexual temptation is not possessed, then it must be remembered to take prophylactic treatment as soon as possible after exposure.

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Section 5.—INDUSTRIAL MEDICINE AND INDUSTRIAL HAZARDS

Industrial Medicine is that branch of medicine which deals with the prevention of diseases and injuries among industrial workers. Strictly speaking, industrial medicine has become of such importance in late years, that it is not now limited to workers, but endeavors to promote good health and increase the life span of the entire people.

Its purposes or aims are to insure good health, the prevention of avoidable accidents, to alleviate unnecessary suffering and thereby provide contentment and promote more efficient work. It further deals with the rehabilitation of diseased and injured persons and reclassifies them to work in such positions as their disabilities will permit, thereby obviating the necessity for their becoming public charges and insuring them a livelihood.

Industrial Medicine is akin to Hygiene and Sanitation and Preventive Medicine, but spreads out to embrace accident prevention as well. Its aims are accomplished by endeavoring to reduce the health and accident hazards to a minimum by education, safety devices and precautions, periodic physical examinations, cooperation of employees, and by the passage of laws for the protection of the workers.

The need for the development of this branch of Medicine is apparent to all, when it is known that in the sixteenth century the average life expectancy of the working man was 22 years, as compared to 44 years for those of the upper classes. The working men were really slaves. They worked from 12 to 20 hours daily, 7 days a week. They were subjected to forms of health hazards about which little or nothing was known. The death of the men was considered a natural course of events.

The value of Industrial Medicine to the workers has been clearly manifest. Today, the average working man in industry may well expect to live to the age of 50 with still a better outlook for the future when the hazards to health and accident are better understood and safety measures are developed and perfected to protect against such hazards.

In this country today, every employee is protected by laws which require that certain standards of protection be maintained against health and accident hazards. Compensation laws are in force to require the payment of disability benefits to those incapacitated by accident or disease which were connected with their employment.

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A National Safety Council was established in 1912 and its slogan of "Safety First" has become a by-word in all homes. In 1914 a health section composed largely of Industrial Surgeons, was incorporated as part of the association. Thus the need of medical advice in industry was established. It is a well-recognized fact that the "human machine" constitutes a very definite hazard to health and accident. The medical man therefore must form a definite part of any industrial organization. Today, the National Safety Council in America is one of the greatest organizations of its kind and by its help has put the working conditions in this country on a very high plane and the industrial worker has reaped the benefits.

Today, every industry in this country, no matter how large or how small, has its medical staff, or its equivalent. Many large industries have their own hospitals and medical staffs; others have contract surgeons but all are required in one form or other to give medical attention to the employees under them. The Government having passed such laws must therefore lead the way in protecting its own employees. The United States Navy is one of the largest of the industries maintained by this Government. An organization has been set up in the Navy to protect its personnel, both civilian and naval. A safety engineer is provided, who acts directly under the Assistant Secretary of the Navy. He has supervision of the safety precautions taken to protect the civilian employees in the navy yards, ammunition depots, torpedo stations and the like. He is also a consultant in all matters pertaining to safety aboard ships, at training stations and other Navy Department activities. A naval medical officer is assigned to his office for the purpose of consultation in all matters pertaining to health and safety and to cooperate in devising means by which health may be protected and accidents prevented. Aside from this particular medical officer, all medical officers, dental officers, members of the Hospital Corps and nurses form the balance of the medical staff of this organization. It is essential that each one of these members know and understand the hazards to be encountered in the Navy, the steps to be taken to protect against injury and disease, the treatment of diseases and injuries arising therefrom and the organization of the medical personnel for such purposes. Naval medical personnel are required to perform duties ashore, at sea, in foreign countries, in the air and under the sea. In each of these places a variety of health hazards exist. It is therefore necessary that this personnel have a thorough knowledge of the industry to which they are attached, the hazards presented, the methods of prevention and the treatment of all injuries occurring.

An occupational hazard is any condition, existing in the trades, which will lead directly or indirectly to disease or injury. No method can be devised for classifying hazards for they are too numerous. However, they may be grouped under the following headings:

1. Those hazards present in the working force by reason of physical defect.
2. Those hazards found in the working places, including hygienic and sanitary defects, mechanical defects of machinery, lack of safety education and the like.
3. Those hazards presented by carelessness of employees. A large majority of accidents are due to this cause alone.
4. Those hazards due to unforeseen influences such as lightning, earthquake, tornado, and the like.

Industrial accidents may be prevented by an understanding of the hazards presented in the foregoing groups, by:

1. Thorough physical examination of all new employees, prior to their actual employment, to discover potential physical defects which would render the em-

ployee a hazard to himself or others. An example of this would be a person with manifestly defective vision being employed as a machinist. Physical examination of all regular employees periodically, to determine their ability to continue working at their trade and to reclassify them to less hazardous work or to retire them, as found necessary in individual cases. Repeated examination of all employees engaged in hazardous trades such as sandblasting, painting, chrome plating, T. N. T. handling, and others, to determine any possible systemic effects present as a result of their trade.

2. A constant and thorough inspection of all shops and working places by the safety engineer, the medical officer, and their assistants to determine the causes of accidents, the hazards to health and the immediate correction of these faults. Education of the employees by means of lectures, motion pictures, posters, and such, will further accomplish much in the line of prevention.

3. The prevention of carelessness by indoctrination of all employees with the spirit of prevention and building up a spirit of cooperation and high morale among them. If necessary, disciplinary measures should be taken when workers are habitually careless.

4. Providing, in so far as is possible, means of protection and escape in cases of disaster.

An exact classification of occupational diseases is difficult, in view of the great number and types of diseases presented by the industry. There is such a great variety and number of skin diseases in the trades that they are generally grouped under the heading of *Occupational* or *Trade Dermatoses*. It is sufficient to state here that practically all diseases and injuries may be associated with industry.

To successfully carry out the objects of Industrial Medicine the medical personnel of the Navy must know:

1. The organization of a safety unit of an industry and the duties of each of the personnel.

2. The hazards to health and accident presented by the particular industry to which they are attached.

3. The methods and means of protection to be established against the encountered hazards.

4. The treatment of industrial diseases and injuries.

5. The laws relating to compensation and treatment of sick and injured personnel, including a knowledge of the necessary reports and returns to be submitted in such cases.

For the purpose for which this book is intended, it seems sufficient to give the hospital corpsmen a general idea of the organization, hazards, protection, treatment and laws as related to the Navy, rather than to try to discuss Industrial Medicine as a whole. This may well be done by discussing the safety organization and its associated duties at a navy yard, for those in force at navy yards are applicable to a greater or lesser degree throughout the Navy. These will be considered in the order given.

Organization.

At all navy yards, the Commandant is the head of the organization. He is responsible to the Navy Department for the protection of the employees, as well as the naval personnel, under his command. He is familiar with the nature of the work being performed by the employees at his station and the health and accident hazards presented. Accordingly, he appoints, as the working head of the organization, a safety officer or a safety engineer, as he is better known. The safety engineer must be of sufficient rank and service to have

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become familiar with the various trades in a navy yard, a knowledge of machinery, a man of cooperative ability and well liked, and having sufficient knowledge of safety devices and appliances to intelligently make inspections and recommend proper protective measures. His duties are primarily, to prevent accidents and promote healthy working conditions. It is his duty to inspect all working places, make a general survey of all mechanical conditions and to recommend the addition of all necessary safety appliances for the protection of the workers. He must make daily inspections of the shops to see that these safeguards are in working order and are being used. He must investigate all major accidents in order to determine the cause and recommend methods to prevent a similar accident. There should be full cooperation between him and the medical officer. All improvements come under his supervision.

The Commandant further assigns a medical officer to act as advisor to the safety engineer. The medical officer must be of the same qualifications as the safety engineer, with the addition that he must be thoroughly versed in the diseases connected with Industry. He need not have a thorough knowledge of machinery but must understand sufficient of the operation of the various machines to intelligently advise the safety engineer in matters relating to the development of safety devices. The duties of the medical officer are as follows, and in this connection it is well for members of the Hospital Corps to understand the nature of these duties in order that they may be of assistance to him in the performance of these duties:

The medical officer is the safety engineer of the human body. He acts as consultant to the safety engineer in all matters pertaining to the general welfare and health of the employees. Hygiene and sanitation are his important duties. He must interest himself in the employees and instruct them in the every day principles of personal hygiene and self preservation. He must instruct the employees in safety measures and encourage them to cooperate in protective measures. They must be made "safety conscious" or "safety minded". The morale must be kept up. A high morale leads to fewer accidents and better workmanship. The medical officer must inspect all working places in order to have a better understanding as to the actual conditions under which the men work. He must make appropriate recommendations to improve deficiencies noted and must then see that these recommendations are carried out. He must personally make all physical examinations of prospective employees or see that the physical standards for employment are adhered to. He must make physical examinations of all employees believed to be physically unfit for further work to prevent them from injuring themselves or others. He must further treat and view the scene of all accidents to be able to determine their cause and to assist the safety engineer in formulating plans to prevent recurrences. He must so organize the personnel under him that prevention will be effectively handled.

The safety engineer is assisted in his work by the foremen of the shops and in some instances by safety committees in each shop elected by the employees. These men or committees are generally chosen from among the older employees and from men who have considerable experience in their trade. It has been repeatedly recommended, but not as yet accomplished, that the safety organization be enlarged by the creation of two new civil service ratings. These are, a civilian safety engineer and a civilian assistant safety engineer. These men would be appointed by competitive examination and should be men who have had considerable experience in the trades with a liberal understanding of all. They would act as assistants to the naval safety officer and would be of great value to the organization, inasmuch as their duties would be permanent. A

naval officer is subject to change of duty and cannot act as permanent safety officer. In changing the safety officers at intervals a weakness is left in the organization which the civilian assistants could well fill, until such time as the new officer became familiar enough with his new duties to take hold.

The organization of the medical advisor is composed of junior medical officers, dental officers, to some extent, members of the Hospital Corps, and of nurses. The duties of the hospital corpsmen are to assist the medical officer in his inspections, assist in the treatment of the injured and to prepare the necessary reports and returns in cases of accident, occupational disease, and the physical examination of employees. This, then, is briefly the organization of a safety unit in a navy yard. This unit will function as well aboard a battleship or in other places. The commanding officer of a ship is the head of the organization. He is assisted by the First Lieutenant acting as safety engineer. Division Officers act as assistants to the First Lieutenant and safety committees are elected in each division from among the crew. The medical officer is the advisor to the safety engineer and he in turn is assisted by the dental officer and hospital corpsmen. All then that is necessary for the unit to function is that a study be made of the hazards presented aboard ship and to proceed as explained later.

Hazards to health and accidents.

The organization completed, a study must be made to determine the hazards existing in the particular organization to which the unit is attached. There are major hazards and minor hazards. A major hazard is represented by unguarded machinery or improperly or faulty insulated electrical wiring. A minor hazard is a greasy shop floor, loose articles lying around on the deck or an open, unguarded hatchway aboard ship. It must be remembered that no two industries present the same hazards. There are hazards peculiar to each trade or profession. Efforts must therefore be made by the safety organization to locate these hazards and afford protection accordingly. To indicate just what types of hazards may be encountered while working with a safety unit of a navy yard and in an effort to make the subject of hazards a little clearer to the readers the following questionnaire, prepared by the inspector of the Medical Department Activities of the West Coast is quoted in part. This questionnaire represents a very thorough picture of the major hazards with which a safety unit of a navy yard must cope, aside from the many minor ones always present in any organization. Answers to these questions must be made not only to the inspecting officer but they must in some form or other be answered daily if the organization is to be successful. By this is meant that problems of this nature are a daily occurrence and the safety unit must be prepared to meet them at once and not wait to formulate answers at inspection intervals.

"Q. 1. What industrial processes employ lead at some stage of the work? This includes tetraethyl lead. How many workers are exposed to lead? What precautions are taken to prevent damage to workers using lead? How frequently are workers using lead checked to determine possible absorption of this element?

"Q. 2. What industrial processes employ chromium at some stage of the work? What precautions are employed to safeguard workers from chromium poisoning?

"Q. 3. What processes create a possible dust hazard? What precautions are observed to prevent damage to workers exposed to dust? Are routine examinations made of the chests of workers exposed to dust? Are X-rays made to de-

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rd protection accordingly. To
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make the subject of hazards a
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of the West Coast is quoted
thorough picture of the major
ard must cope, aside from the
ganization. Answers to these
cting officer but they must in
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are a daily occurrence and the
once and not wait to formulate

d at some stage of the work?
ers are exposed to lead? What
workers using lead? How fre-
termine possible absorption of

romium at some stage of the
guard workers from chromium

hazard? What precautions are
to dust? Are routine examina-
dust? Are X-rays made to de-

termine the presence of silicosis in workers exposed to dust? Have cases of silicosis developed?

"Q. 4. What industrial processes produce fumes which may be a health hazard? How are these fumes controlled?

"Q. 5. What industrial processes produce carbon monoxide in possible dangerous concentrations? What industrial processes produce carbon dioxide in possible dangerous concentrations? Have any cases of poisoning from these sources occurred?

"Q. 6. What processes employ volatile solvents during some stage of the work? Are aniline compounds used? Has damage occurred from their use?

"Q. 7. Are organic wax compounds used? Has damage occurred?

"Q. 8. What precautions are exercised to prevent damage from pipe covering compounds? What asbestos hazards exist?

"Q. 9. What precautions are taken to prevent damage from glass wool?

"Q. 10. What radio-active compounds are used on the station and what precautions are used to prevent damage from this and luminous paints?"

These are but a few of the questions asked but they serve the purpose for which they were intended, i. e., to indicate just what is meant by a health hazard and ones which must be studied in Industrial Medicine.

Protection.

Having made a survey to determine the hazards presented in the organization to which one is attached, means of protection must be sought. This is done first by protecting against physical hazards by employing physically fit men. In the Government, the physical standards are set according to the employment and the hazards to be met with in each type of work. The U. S. Civil Service standards are as follows:

1. For employment in arduous duties. Must be physically sound and in good health, active and able bodied. Rating "A". For some positions e. g. divers, requirements are specially rigid. Rating "A plus".

2. For less arduous employment. Requiring sound general health but less physical strength, though for some employment special requirements exist, i. e. perfect color preception for brakemen and chauffeurs. Rating "B".

3. For lighter and usually sedentary employments. General good health but minor anatomical defects not interfering with efficient performance of work may be passed, i. e. a typist may be lame.

Next, having employed a healthy working force it is necessary to protect their health. Proper working places must be provided and maintained. Hygienic and sanitary conditions must be kept on a high plane. All moving parts of machinery must be guarded; goggles provided for workers required to use them; helmets and masks for sand blasters; proper ventilation for the chrome workers; masks for asbestos workers; protection for workers in X-ray and radium; protective gloves, shoes, and other garments for foundry workers, and other means of protection too numerous to mention here must be available and used.

Special physical examinations must be made of all sand blasters, asbestos handlers, those exposed to radium and its compounds, lead workers, those engaged in dusty or smoky trades, handlers of T. N. T. and other explosives, etc., to prevent the occurrence of the diseases associated with those trades from injuring the men.

As mentioned before, all workers who are sick for any length of time and whose efficiency has fallen off because of physical reasons must be examined and either retired or reclassified.

Treatment.

The treatment of industrial diseases and injuries is essentially that for any others. All accidents are treated according to the severity and locality. Men are not allowed to treat themselves for even minor accidents by reason of the dangers of infection and later incapacity. The treatment of diseases of occupation is a specialty in itself and need not be considered here.

Laws governing workers and accidents occurring during work.

The laws governing occupational diseases and injuries are quite numerous. It is therefore essential that a hospital corpsman be familiar with only those pertaining to Government employees. These, in general, are as follows:

All men injured or taken sick during the course of their employment are required to report to the dispensary for treatment. It makes no difference how trivial the accident or how minor the illness, he must still report. No first-aid boxes are allowed in any of the shops or offices. When a man reports, his injury or illness is investigated, treated, or otherwise disposed of. At the U. S. Navy Yard, Puget Sound, Wash., a form report of the case is prepared in quintuplicate, two copies of which are forwarded to the safety engineer, one copy is sent to the foreman of the shop or the supervisor of the office, one is given to the employee, and one placed in his file jacket. A separate file jacket is maintained for each employee who reports to the dispensary for treatment or for any other reason and is a permanent record which is kept during the entire time of employment. The information furnished on this report is as follows: Date; whether report is of injury or return to work; name; rating; pay number; shop; diagnosis; date and hour of injury; date and hour reported to dispensary; whether or not injury is due to employment; disposition (treated and returned to work, given time off, or transferred to naval hospital); name of medical officer treating case; and patient's statement regarding injury.

In addition to this form, a card-index form, U. S. Employees' Compensation Commission Form CA–19, is made out in each case. This form is started when the man reports and when final disposition of the case is made it is likewise filed in the man's jacket.

When an injured employee returns to his shop or office, or when the foreman or supervisor receives his copy of the form report, the foreman or supervisor immediately fills out U. S. E. C. C. Form CA–2, and forwards it to the injury officer, who, in turn, submits it to the dispensary for completion by the medical officer treating the case. The medical officer gets the data for this report from the forms previously described.

U. S. E. C. C. Form CA–3 is forwarded at the termination of total or partial disability of an employee, or upon his death.

U. S. E. C. C. Form CA–4 is a claim for disability allowance or compensation for injuries received which must be submitted by the employee within 60 days after the injury. This form must also be completed by the medical officer attending the case and once again the form report and U. S. E. C. C. Form CA–19 are of value.

U. S. E. C. C. Form CA–8 is similar to Form CA–4 but must be submitted on the first and sixteenth of each month by the employee, during the period of his disability.

When it becomes necessary for an injured employee to have hospital or other treatment not provided by a dispensary or local physician, U. S. E. C. C. Form CA–16 is made out and forwarded with the patient to the hospital or place where he is to receive such additional care.

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Times arise when there is doubt as to the origin of the disability, i. e., whether or not the disability is occupational. In such cases U. S. E. C. C. Form CA–17 is substituted for Form CA–16. Whenever U. S. E. C. C. Forms CA–16 and CA–17 are made out they must be accompanied by U. S. E. C. C. Form CA–20.

U. S. E. C. C. Form CA–21, Discharge Report of Injury Case, is forwarded when an employee is discharged from treatment after having been incapacitated by reason of occupational injury or disease.

U. S. E. C. C. Form CA–32 is a report of hernia and must be submitted in all cases in which claim is made that a hernia was caused by employment.

Numerous other forms, such as public bills for payment for treatment, are used in handling these cases, but as they are accomplished by the injury officer they are not listed here.

Forms showing reports of all physical examinations of employees, including the special examinations previously mentioned, are also kept. These are routine however, and are easily learned when actually engaged in this work. Special forms for W. P. A., E. R. N., and P. W. A. workers are also provided.

In conclusion, it is well to state the qualifications expected of a hospital corpsman engaged in Industrial Medicine.

1. He should realize that his first duty is to the workman who is injured.
2. His personality should inspire confidence.
3. He should have a knowledge of first aid.
4. He should have a knowledge of an efficient medical record system and of statistical methods.
5. He should have a knowledge of sanitation, of working conditions, of occupational hazards and preventive measures.
6. He should possess a general knowledge of industrial relations, including employment, its methods and problems.
7. He should have a working knowledge of the workmen's compensation laws.
8. It would be well for all hospital corpsmen to obtain and read the publication Medical Service in Industry and Workmen's Compensation Laws, 1938, published by the American College of Surgeons as prepared by M. N. Newquist, A. B., B. Sc., M. D., to enhance their knowledge of this subject and thereby be of more value to the medical organization of the Navy for industrial medicine. This publication contains concise, complete statements of the problems of the industrial organization and is of value to all industries.

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Section 6.—FIELD SANITATION

Health is necessary in war, and cannot be replaced by anything else.—Napoleon

Introduction.

The activities of a medicomilitary organization tend to concentrate toward one primary objective, *"The conservation of physical efficiency for combat."* The hospital corpsmen of the Navy serve ashore, as well as afloat, and in